SUPPLEMENT TO THE CHEMICAL NEWS, JULY 6, 1888.

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

VOLUME LVII.—1888.

LONDON:
PUBLISHED AT THE OFFICE, BOY COURT, LUDGATE HILL, E.C.
AND SOLD BY ALL BOOKSELLERS.

MDCCCLXXXVIII.

LONDON:

PRINTED BY EDWIN JOHN DAVEY.

BOY COURT, LUDGATE HILL, E.C.

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THE CHEMICAL NEWS.

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No. 1467.—JANUARY 6, 1888.

ON THE

OCCURRENCES OF CHROME IRON ORE IN AUSTRALASIA.

By R. W. EMERSON MACIVOR, F.I.C., F.R.G.S., F.C.S.

As I have had occasion to examine the deposits of chrome iron ore which occur in different parts of Australasia, with the view of turning them to commercial account, perhaps the following notes may have an interest for chemists, mineralogists, and manufacturers.

The ore is found in quantity in two or three places in New Zealand, but chiefly in the neighbourhood of Nelson, in the Middle Island. It exists in various forms, distributed throughout what is locally known as "the Mineral Belt"—a broad band of serpentinous and olivine rocks, which can be traced for a distance of about fifty miles from D'Urville's Island in Cook's Straits to the mountain called Little Ben Nevis. These varieties are:—(1) *Massive Crystalline*, in bands of black, highly crystalline character, which, on being fractured, show distinct planes of octahedron, and sometimes—though rarely—perfect crystals. (2.) *Massive Amorphous*, having a brown-black appearance, and somewhat softer in nature than the preceding. This form is usually met with in well-defined bands, which, unlike those of the crystalline massive variety, are remarkable for length and breadth. (3.) *Crystalline Disseminated*, in the condition of nodules, or spherical segregations, having a diameter of from 1-10th to ½in., distributed more or less evenly through the green serpentinous rocks. This ore presents somewhat the appearance of a conglomerate, and is called "pudding stone" by the local miners. On exposure for a week or two to rain and sun the rock loses its green colour and crumbles away to a soft impalpable white powder, leaving the nodules of chromite so that they can be easily and completely separated by mere washing or screening. The nodules have a fracture identical with that of the massive crystalline variety, and are very rich in chromic oxide.

In order to convey an idea of the mode of occurrence of the several kinds of ore in the same mine, perhaps the accompanying rough sketch of an open working, made under my direction on the summit of Little Ben Nevis, may be useful.

A, A, A are seams of dark green rock containing nodular chromite between the layers of massive crystalline ore; C, C, C and B, B, B are patches of "pudding stone."

The face of the working was about 150 feet wide, and nearly 50 feet in height. It will be seen that the crystalline massive ore occurs in "patches" or "pockets," and in these in seams which approach the vertical in position, whereas the amorphous massive variety exists in lodes more or less approaching the horizontal. It may be remarked that much of the "pudding stone" consists of segregations held together by only a small proportion of rock, from which they can be readily separated, even without weathering. From 15 tons of the stone I have obtained as much as 13½ tons of chromite free from matrix, while from the same weight of a poorer sort only 3¼ tons were obtained. No difference, however, existed in the quality of the nodules themselves, as they contained from 59·8 to 68·9 per cent of chromic oxide, whether obtained from rich or poor "pudding stone." The largest "pocket" of crystalline massive ore which I found at Ben Nevis contained about 68 tons of 55 to 62 per cent stone.

How far my observations concerning Ben Nevis are applicable to other parts of "the Mineral Belt" it is difficult to say, though the long experience of the late Mr. T. R. Hacket, who worked the Dun Mountain for an English company, seems to indicate that the richest ores do not occur in well-defined lodes of any length, but rather in the detached "patches" or "pockets" I have described. I am satisfied, however, that the sleepy little city of Nelson will some day reap much benefit from the working up of the vast stores of chrome iron ore in its vicinity. The following is a statement of the percentages of chromic oxide in the ores occurring within easy distance of the town and nearly all on the line of "the Mineral Belt":—

Aniseed Valley:—	
(a.) Crystalline Massive ..	52 to 56
(b.) Amorphous ,, ..	42 ,, 51
(c.) Nodular	56 ,, 69
Adam's Lode:—	
Crystalline Massive	57 ,, 65
Maungatapu:—	
(a.) Crystalline Massive ..	53 ,, 64
(b.) Amorphous ,, ..	30 ,, 50
Croxilles:—	
(a.) Amorphous Massive ..	40 ,, 46

The average ore of the Province of Nelson could easily be maintained at 55 per cent of chromic oxide—and even 60 per cent is possible.

Chromite, as I have already hinted, is also found in other localities in Southern New Zealand, but it has not been met with in the North Island in sufficient quantity to attract attention.

The ore has been extensively exported from New Caledonia during recent years, and judging from some large cargoes which I examined in Sydney, appears to be in many respects similar to the Ben Nevis stone. The

mines are situated about 20 miles from Noumea, the capital of the colony, and the abundance of cheap native labour available for conveying it to shipboard enable the exporters to do their work much more cheaply than is possible in either New Zealand or Australia.

Neither Victoria nor South Australia has yet been found to possess any very extensive deposits of chromite, though in the former colony a considerable quantity of good ore is said to exist in the shire of McIvor.

Large quantities of the mineral occur in the serpentine formations at Jundagai and Tamworth in New South Wales, but the cost of labour, railway carriage, and the present low price of even the best stone, will prevent the supplies from being utilised for a long time to come.

Chrome ore has been discovered in many localities in Queensland, but for most part in places which are at present all but inacessible. It can, however, be obtained in any quantity in and around the Pine Mountain district, near Ipswich, where there are are large areas of serpentine country. The ore is of the amorphous and crystalline massive varieties, and contains from 42 to 60 per cent of chromic oxide. Mines could be opened up very cheaply, and there is ample facility for bringing the ore to Europe.

That there is abundance of chromite in Tasmania I have no doubt whatever, but even if it should be found on the coast the difficulties in the way of shipping it will prevent anything like extensive mining operations for many years to come. Though somewhat foreign to the object of this communication, I may mention where the unexpected occurrence of the mineral did a serious injury to the industrial progress of the whole colony. On the Tamer River, opposite Georgetown, extensive works were put up at a cost of nearly £100,000 to utilise the splendid deposits of rich hæmatite in the locality, but it was soon found that the pig-iron obtained was not marketable in the colonies, owing to its containing from 3 to 7 per cent. of chromium, and the whole enterprise forthwith collaped. The hæmatite occurred in a serpentine formation, and there were disseminated throughout its mass minute veins of chromite. Hence the chromeisen obtained from the blast furnaces.

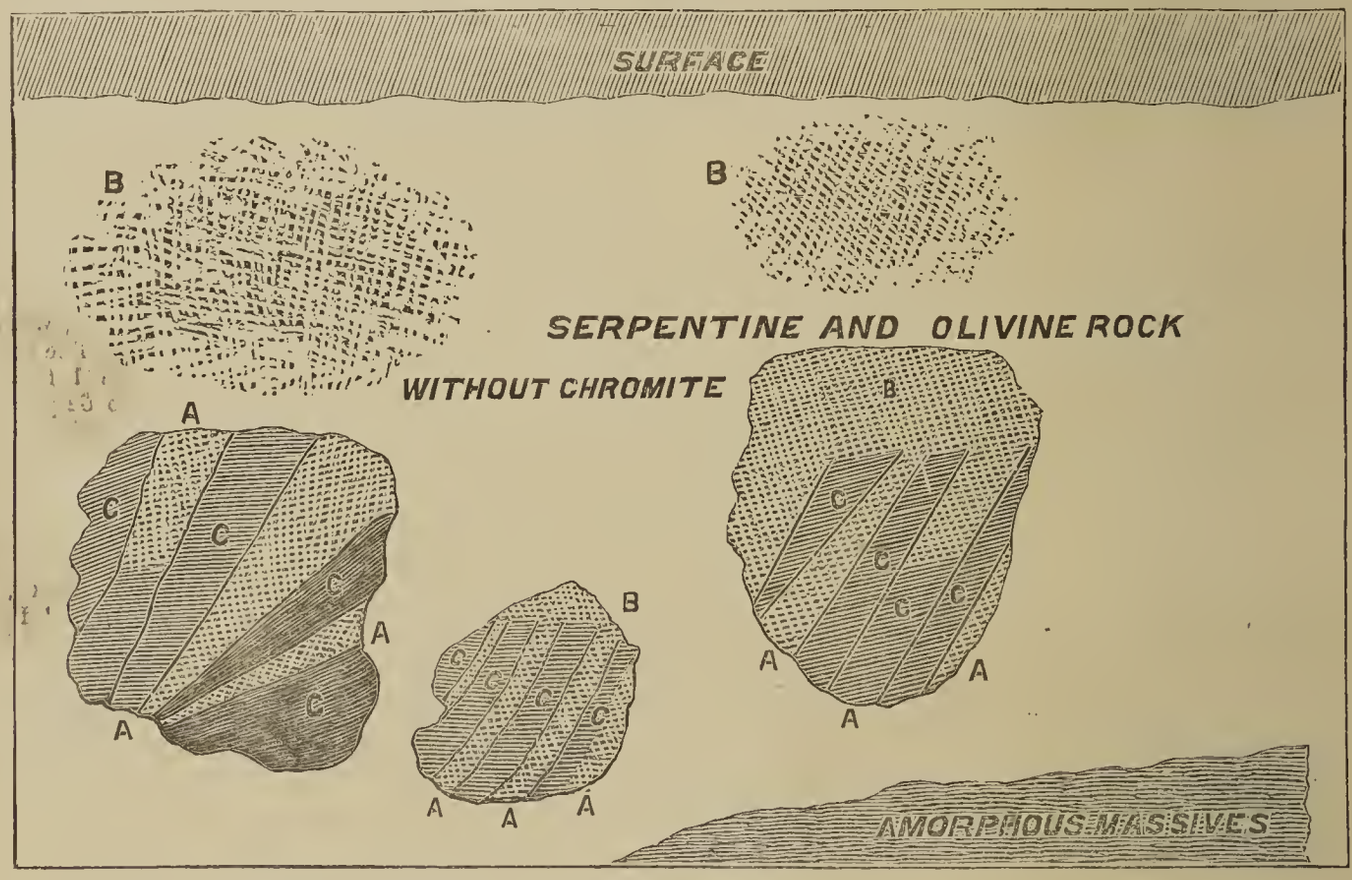
ATTEMPT AT A DIAGNOSIS OF THE VOLATILE ALKALOIDS.

By M. OECHSNER DE CONINCK.

We may characterise a pyridic alkaloid, following the order of the reactions indicated previously.

First reaction :—We obtain deep red solutions, the tint of which is brightened by acids and destroyed by alkalies in excess. These solutions do not generally become fluorescent.

Second reaction :—We obtain at first neutral colours of a deep red colour, brightened by acids and destroyed by an excess of alkali ; their solutions in different mediums (water, ether, alcohols) become very fluorescent after about 10 to 15 hours. There is then formation of pyridic dihydrides highly reductive and possessing a very peculiar odour. In the final stage of the distillation hydrocarbons may be collected over water.



Third reaction :—We obtain solutions having a fine fluorescence ; a part of the alkaloid is regenerated, another part hydrogenised, and the hydride formed has a strongly reductive action.

Fourth reaction :—There is formation of a double platium salt.

Fifth reaction :—The chloraurate formed is generally more stable than the chloroplatinate in presence of boiling water. Still, in certain conditions, it may lose 1 mol. of HCl.

Sixth reaction:—There is formed principally a dipyridyle, a thick, oily liquid, heavier than water, and very slightly soluble in it.

Dihydropyridic Alkaloids present coloured reactions which are very fugitive. Luke-warm water modifies their chlroroplatinates, often decomposing them. The chloraurates are rapidly reduced in the acids.

Hexahydropyridic Alkaloids.—Under this name are included a number of well-known alkaloids, such as piperidine and cicutine. Their iodomethylates and iodoethylates do not yield coloured reactions ; their gold and platinum salts are sometimes stable and sometimes unstable, and are

not polymerised by sodium. This metal converts some of them into derivatives, which are decomposed by water with regeneration of the alkaloid.

Dipyridic Alkaloids.—Their iodomethylates give very distinct colour reactions with potassa. Their platinum and gold salts are sometimes stable (nicotine), sometimes unstable (sparteine). If the liquid is distinctly acid the stability of these salts is most frequently increased.

Hydrodipyridic Alkaloids yield coloured reactions analogous to those of the dipyridic bases, but more fugitive. The salts of gold and platinum are very unstable.

Quinoleic Alkaloids.—Their iodomethylates and iodoethylates yield coloured reactions, due to the formation of *cyanines*, and give rise to crystalline colouring matters. The gold and platinum salts are stable in presence of boiling water. The chloroplatinates are modified only in presence of an excess of free base. They are polymerised by sodium.

Tetrahydroquinoleic Alkaloids. — Coloured reactions fugitive in consequence of phenomena of reduction. The salts of gold are decomposed in the cold; those of platinum are more stable, but are modified by hot water.

Aromatic Bases, their iodomethylates, &c., do not give coloured reactions with potassa. The platinum and gold salts very stable, or very unstable in presence of water. Not polymerised by sodium.

Bases of the Fatty Series.—Their iodomethylates do not yield colour reactions in an alkaline medium. The platinum and gold salts generally very persistent in the presence of water. Not polymerised by sodium.—*Comptes Rendus* (Vol. cv., No. 25, p. 1258).

ANALYSIS OF A CRYSTALLINE SCALE FORMED IN THE MANUFACTURE OF SODIC BICARBONATE BY THE AMMONIA PROCESS AT SYRACUSE, N.Y.*

By GEORGE W. LEIGHTON.

The material here described was deposited on the inner surface of an iron tank in which vapours consisting of NH_3,CO_2, with small quantities of H_2S, are passed through brine holding in solution NaCl, $MgCl_2$, $CaCl_2$, and $CaSO_4$. It has the appearance of a boiler scale from one to two inches thick, semi-transparent, with a vitreous lustre and of greenish grey colour, although sometimes black on the surface. The scale is usually covered with crystal planes, which have at first sight the appearance of octahedral forms projecting from the surface, but on closer examination the planes were found to be the terminations of prisms extending down into the body of the scale. The faces were somewhat curved, and so irregular as to render accurate measurements with the reflecting goniometer impossible. Attempts were made to obtain approximate values by cementing to the faces bits of thin microscope glass, but the results were discordant. The crystals seemed to have a monoclinic habit, and to consist of an oblique rhombic prism terminated by two pairs of planes of the positive and negative hemioctahedrons. For the prismatic angle we obtained 57° 46′, and for the positive and negative octahedral angles an average of 69° and 75° respectively, but with a variation of more than three degrees between measurements on different crystals. We observed a well-marked cleavage parallel to the assumed plane of symmetry; also a second cleavage—inclined to the prismatic edges, and marked by striations on the prismatic planes—parallel to the assumed basal section. There were also indications of both ortho- and clino-domes; and from these features, as well as from the mode of twinning, it is highly probable that the crystallisation is monoclinic, but the evidence is not conclusive.

A qualitative analysis showed that the material was composed chiefly of sodium and magnesium in combination with carbonic acid and chlorine, with a small amount of calcium, and a trace only of iron. The scale, when pulverised, was decomposed by water, all of the sodium salts and part of the magnesium passing into solution upon digestion with a sufficiently large volume of boiling water, but from this solution all the magnesium was thrown down on concentration as carbonate.

In the quantitative analysis the alkali was determined in two ways; first, by extraction of the sodium salts with water and the separation of the magnesium by concentration; secondly, by the regular Lawrence Smith method; and concordant results were thus obtained. The magnesium, calcium, and iron were separated in the usual way. Chlorine was determined by precipitation with argentic nitrate from a solution of the scale in nitric acid, and the CO_2 was determined by loss on treating with acid in a small apparatus adapted for the purpose, and also by absorption in potash bulbs. The results are given below.

Taking now the means of these determinations, and assuming that the chlorine is combined with sodium, while the carbonic acid is distributed among the rest of the base, we obtain as the final average result of the analysis:—

	Found.	Theory.	Diff.
NaCl	22·230	22·23	
Na_2CO_3	40·622	40·28	−0·34
$MgCO_3$	31·569	31·92	+0·35
$CaCO_3$.	3·559		
$FeCO_3$.	0·080		
H_2O	0·630		
CO_2 in excess ..	0·645		
	99·335		

It will be noticed that CO_2 is present in slight excess over the amount required to form neutral carbonates, indicating a small admixture of bicarbonate. The water is obviously hygroscopic, and the minute amount of iron an impurity. Excluding also from consideration the small amount of lime whose relations to the mass cannot certainly be determined, it appears that the three chief ingredients of the crystalline scale are present very closely in the proportion of their molecular weights. This is shown in the column headed Theory, which gives the amounts of Na_2CO_3 and $MgCO_3$ corresponding to the amount of NaCl found in the material analysed, on the assumption that this is a triple salt represented by the symbol $MgCO_3.Na_2CO_3.NaCl$.

By comparing the determinations of chlorine which form the basis of this calculation, it will be seen that the amount of NaCl must be known with great accuracy, and

* *Proceedings of the American Academy of Arts and Sciences.*

Substance estimated.	Number of Analysis. 1.	2.	3.	4.	5.	6.	7.	8.
H_2O at 100° C. ..					0·31	0·39	0·395	
H_2O at 230° C. ..	0·63	0·63						
CaO			2·02	1·99	1·96	1·96	2·05	
FeO	0·045	0·054						
MgO			14·90	14·77		15·34	15·12	
Na_2O	38·71		38·45	38·57				
Cl	13·45		13·46	13·45				
CO_2	36·24			35·33	35·65	35·46		35·54

the column of differences shows that the calculated values of $MgCO_3$ and Na_2CO_3 differ from results of analysis within the limits of experimental errors. By withdrawing from the total weight the small amount of base assumed to exist as bicarbonate, corresponding to the excess of CO_2 shown by analysis, and making also the very probable assumption that the calcium found replaces the magnesium in the triple salt, we should obtain very nearly the same results as before; but such a calculation would rest on uncertain data, and add nothing to the strength of our general conclusion.

It is evident that the crystalline scale is a double carbonate of magnesium and sodium united in molecular proportions with common salt, and mixed with a small amount of impurity; but the amount of impurity is very small, considering the conditions under which the scale is formed. That the chloride is combined, and not simply mixed with the carbonate, is shown, not only by the definite proportions, but also by the fact that the material is so slowly acted on by water, which evidently acts as a decomposing agent, and not solely as a solvent. The scale is then a definite crystalline product, having a very interesting constitution, not unlike that of several well-defined mineral species.

LEAD SLAGS.

By MALVERN W. ILES.

Smelting is a chemical operation, and a study of the nature of slags forms the science of smelting. It will therefore be seen that the field is an exceedingly broad one, and that even in the treatment of a particular kind or class of slags, as produced by shaft furnaces for the treatment of argentiferous lead ores, it will not be possible within the limits of this paper to give all of the important data, but simply to briefly state such salient points as have come within the notice and experience of the writer. The subjects discussed will be classified as follows:—

I. *Physical Properties.*—(1) Density. (2) Crystalline form. (3) Colour. (4) Lustre. (5) Fluidity. 6. Fusibility. (7) Magnetism. (8) Friability. (9) Influence of slow and rapid cooling.

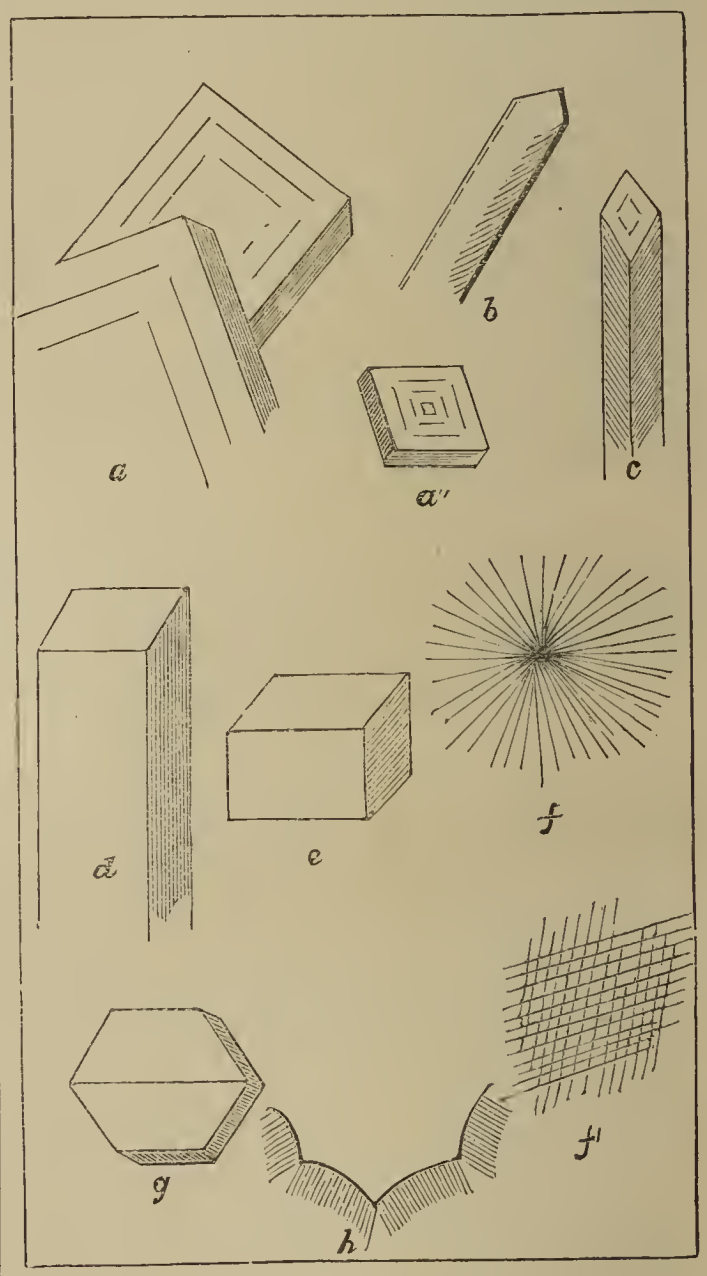
II. *Chemical Properties.*—(1) General composition. (2) Modes of decomposition. (3) Quantitative analysis. (4) Analytical data. (5) Types.

Physical Properties.

Density.—The specific gravity of slags formed in argentiferous lead smelting has been found to be very variable. The minimum noted was 3·3, and the maximum 4·16; the best slags, however, may be stated to have a density of 3·4 to 3·65. Iron, barium, and lead cause high specific gravities, while silica, lime, and alumina have a tendency to diminish the weight. The average density of one hundred samples taken daily in 1880, at Leadville, during very fair work, was found to be 3·691. A series of experiments was conducted on this subject for over a year without arriving at any very positive or satisfactory results. It is now believed that difference in density alone cannot be used as an infallible guide, but should only be regarded as an auxiliary for a thorough study of slags.

Crystalline Form.—Most slags show some tendency towards crystallisation. A few have been noted in which the crystallisation was very imperfect, yet the silver and lead losses were small; these, however, were exceptions, and not the rule. In general the more crystalline a slag is the better it is, considered both from an economical and a metallurgical standpoint.

The centre or "heart" of a cooled pot or cone of slag is always found to be the most crystalline: this tendency diminishes outwardly in all directions until next to the surface is a thin crust or scale devoid of a crystalline structure, and presenting a thin vitreous or glassy scale. This scale is the result of rapid cooling of the slag as it comes in contact with the iron pot. If the grade of bullion produced is not quite high (say over 300 ounces of silver per ton), and the lead charge is not very low, it is rare to find a very crystalline slag containing more than 1 per cent of lead or more than 2 ounces of silver per ton; generally these markedly crystalline slags show a much smaller loss than this. A very careful study of the crystalline form of lead slags will unquestionably enable a skilled metallurgist to identify the type of slag produced,



Crystalline Forms of Lead Slags.

to tell within reasonably close limits the general composition, and to form a comprehensive idea as to the losses in both lead and silver.

The most important crystalline forms of slags are either large thick plates or leaves; thin plates, often semi-translucent and frequently marked with striæ; monoclinic prisms, which may be either inclined or rectangular; several modifications of the cube; delicate needles, which may or may not radiate from a central nucleus; hexagonal plates; and lastly, what may be termed for convenience botryoidal and pectolitic crystallisation. These various forms are shown in the diagrams here given. There seems to be a distinct connection or relation between the crystalline form and the chemical composition of these

slags, as it will be endeavoured to show when the subject of "types" is considered.

Colour.—Lead slags are almost always black, or of some dark shade. The darkest slags are those containing the most iron; yet iron will sometimes give either a reddish tint, due to the presence of a small amount of Fe_2O_3, or have a slight greenish cast. Lime tends to lighten the colour, giving the slag a stony or earthy appearance. Manganese in large quantities gives a reddish to amethystine hue; and when the manganese is associated with 20 per cent CaO, and over, the slag very often has a resinous colour, closely resembling blende. Zinc in the presence of alumina, some manganese, and much silica (from 36 to 37 per cent) gives a colour very closely resembling porcelain or obsidian: this is especially true of the outer rim of the pot (see analysis, further on). Lustrous black slags are always due to the presence of much iron. Some exceedingly siliceous (38 to 42 per cent silica) have a greenish cast.

Lustre.—Most of the slags formed in lead smelting are vitreous, although the high lime and also the very high iron slags are not as a rule vitreous. The lustre is rarely pearly, often resinous; submetallic, splendent, also pitchy; in short, they possess lustres analogous to those of the unisilicates and bisilicates as formed in nature.

Fluidity.—Thick, viscid slags almost invariably occasion losses in both silver and lead; generally the more fluid a slag is the more perfect will be the separation of lead, and consequently that of the silver. When the fluidity is entirely dependent upon iron there is a liability to iron crusts, and these will then produce great losses. Scientific smelting should aim at obtaining a fluid slag, a slag built up to approach some one of the recognised types. Silica is the chief cause of viscidity in slags, although even a properly calculated slag will sometimes run viscid owing to a lack of fuel, or soon after starting up or "blowing in" a furnace. During heavy snows or rains, or in exceedingly cold weather, the slag may run viscid because of an insufficiency of fuel.

Manganese increases the fluidity of slags to a marked degree, often rendering even siliceous slags fluid. Lime may or may not make a fluid slag; most high lime slags flow with a smooth oily flow, fluid when hot and either stringy or brittle according to the other ingredients present. Some slags are so fluid and smelt so fast, especially when the ore charge is coarse, that they do not allow a perfect separation of lead and silver; under these circumstances the furnace is said to "drive too fast."

Fusibility.—Generally the more fusible slags are the more economical they are; they require less fuel, drive faster, often prevent "over fire," cause a more perfect separation of the valuable metals, and should be the aim of the lead smelter. Easily fusible slags do not always give rise to very bright tuyeres, although they usually show a light, and the scale or crust immediately in front of the tuyere is quite thin.

Silica lessens the fusibility; manganese and iron always increase it; while magnesia and zinc rarely, if ever, cause a more fusible slag. Alumina may or may not increase the fusibility of lead slags. If the percentage of silica is low alumina plays the *rôle* of an acid, and hence increases the fusibility; if, however, the percentage of silica be high, then alumina acts as a base, and hence lowers the fusing-point of slags. This statement has been arrived at after many long and extensive experiments, involving the smelting of many thousand tons of ore. The closer certain recognised slag types are approached, the greater will be not only the fluidity but also the fusibility. It is, however, not always an economical mode of procedure to adhere too rigidly to any general form of slag.

The subject of the fusibility of slags cannot but be regarded as one of the chief points to which the lead smelter should direct attention in the treatment of silver-bearing lead ores by means of the shaft furnace. Prof. Gordon, in his translation of Grüner's "Studies of Blast Furnace Phenomena," makes the following valuable remarks:—"There is, however, a considerable difference in the temperature required for the complete formation of different slags. According to Plattner's experiments, although the temperature of fusion of the slag itself, when formed, varies much less for different proportions of acid and bases, forming singulo-silicates, bisilicates, and trisilicates, the temperature at which slags are formed varies considerably. In general, singulo-silicates require a higher temperature for formation than bisilicates; and of singulo-silicates those of alumina form at 2400° C., magnesia form at 2200° to 2250° C., baryta form at 2100° to 2200° C., lime form at 2100° to 2150° C., iron and manganese form at 1789° to 1832° C.

"The silicates of oxides of manganese and iron (protoxide) differ very little from each other. The bi- and trisilicates of the different earths are formed at a lower temperature. Of the bisilicates those of baryta and lime form at 2100° C., baryta and alumina form at 2050° C., lime and magnesia form at 2000° C., lime and alumina form at 1918° to 1950° C.

"The temperature required for the formation of compound silicates from the earths composing them is very much higher than that at which slags which have been already fused can be melted. As the slags coming from smelting processes are seldom formed by fusing together these independent components, but more frequently from a mixture of silicates already formed, partly from the ores, &c., and generally of manifold combinations of the oxides of the earths, the temperature required for the formation of the new slag or compound silicates will lie between their point of fusion and the temperature which would be necessary to form this new slag from the simple substances.

"Refractory slags, which are always indications of faulty working of the furnace, arise either from insufficient temperature or from injudicious combination of the charges,—as when too much silica and too little of the bases, or the contrary, are present, or if among the bases there be an excess of alumina and magnesia. Such slags are recognised by their pasty nature, their earthy, half-fused appearance, and by the air-holes pervading them. On the other hand, the charge is a good combination when the slag flows out at a good consistency, as free from metal as possible, and when, for a given consumption of fuel, the maximum of ores can be used."

Dr. Percy, while objecting to the principle of Plattner's method, because it assumes that alloys of gold, silver, and platinum fuse at the mean temperature of the component parts, says we may accept his results as affording practical information of value. "The melting-points of metals and their alloys are fixed and unvarying, except under extraordinary conditions of pressure, and as they extend through a very wide range of temperature they may be conveniently employed in the determination and comparison of high temperatures." Plattner himself considered that he had only determined temperatures "correctly proportioned to each other, and not absolute thermometric limits."

In this connection it will be well to quote a few lines from Overman, which, while they are in the main correct, contain one or two statements which are subject to limitations and corrections when viewed from a lead smelter's standpoint. "If," says Overman, "a compound of lime and silex melts at 3000° C., that of protoxide of iron and silex at 2000°, and that of a silicate of oxide of lead at 1000°, the mean heat of the three, by which they melt when mixed together, is not—

$$\frac{3000° + 2000° + 1000°}{3} = 2000°,$$

as their various degrees indicate, but it may be only 1500°, and in this case even lower than that." The above statement is unquestionably correct. Then follows this remark:—"The greater the number of elements in a slag the more fusible it becomes; it is therefore of the utmost

importance, in all smelting operations, to multiply the kinds of ores: this produces fusible slags and fusible metals." In general, multiple bases do produce a more fusible slag than where only a few bases are present; but there are certain notable exceptions to this rule or law in the cases of zinc, alumina, and magnesia. No intelligent lead smelter would for a moment think of adding zinc simply that there might be a larger number of bases to enter the slag; nor would it be policy to add either alumina or magnesia. For some reason, not as yet very clearly understood, magnesia has been found to increase the silver losses to a remarkable extent. The latter portion of the above quoted passage, in regard to multiplying the different kinds of ores, is the proper mode of procedure, from other considerations aside from the simple fact of fusibility. Overman also says "Slags should be as fusible as the metal which is to be smelted with their assistance. If they are more refractory than the metal, the slag causes it to assume a heat by which more or less of it is evaporated." Since lead melts at or about 325° C., the probabilities are that very few lead slags have this low fusing-point.

While there are a number of substances which will make fluid slags, yet, owing to the cost and the difficulty of procuring them in large quantities, we must therefore of necessity use either iron, lime, or manganese. The proper and economical use of these bases, in localities where the ores to be smelted are highly siliceous (and this is generally the case), becomes a matter of either profit or loss in carrying on this industry. The problem, in other words, may be stated thus:—How shall we cause the largest amount of silica to be fluxed off into the slag, and at the same time use as little costly bases as possible, producing a fusible and clean slag?

Magnetism.—In December, 1879, it was discovered that the slags produced at the old works of the Grant Smelting Company were all magnetic: thinking that perhaps this might be peculiar to this kind of slag, 108 samples were collected, including specimens from all the furnaces of the different works at that place, and in every case the same property was observed. The entire mass of some slags was found to be attractable by the use of an ordinary horseshoe magnet. An attempt was made to discover some relation between the intensity of the magnetism and the lead and silver losses, but so far without obtaining altogether satisfactory results.

Experiments were instituted clearly demonstrating that this magnetic property was not due to fine particles of metallic iron mixed with slag. It was also noted that it was exceedingly rare to find an ore from this locallty which is not in part attracted by the magnet, and, by panning or concentrating these ores, the black magnetic oxide of iron, (Fe_3O_4), so common in placer mines, will be found. It may therefore be said, as a partial explanation, that this magnetic sand passes into the slag, giving it this property. It is possible that the reducing power of these furnaces was imperfect, for example, due to a lack of fuel; but the smelters at this time were inclined to use more fuel than has since been found necessary for good work. An oxidation at the tuyeres may also give rise to this phenomenon, as, for example, by using too strong a blast. I have found that even siliceous slags are more or less magnetic; all lead slags containing from 25 to 55 per cent of ferrous oxide, and even high lime slags, also are magnetic; hence the chemical composition seems to have little or no effect upon the magnetic property of slags. Of course, if magnetic oxide of iron enters the slag *as such*, it implies necessarily a waste of precious flux: yet I am of the opinion that the magnetic property is due to (1) an unavoidable mixture of some ferric silicate; (2) to the ferrous silicate itself; and (3) in many cases to the presence of iron matte: this is especially true where very impure ores are treated and the production of matte is large. The mineral fayalite is a silicate of protoxide of iron, yet it is attractable by the magnet. I find that iron matte (Fe_2S) is always more or less magnetic, therefore a part of the magnetic property is often due to this cause.

The slags produced at all the prominent smelting works in this country show more or less a magnetic property, and samples of slag from many of the abandoned dumps have this same characteristic; therefore I am led to the conclusion that this is a general property of lead slags.

If it can be shown that the magnetism of lead slags is due to sesquioxide of iron, more than nine-tenths of all the analyses of lead slags are incorrect, as it is exceedingly rare to find a slag analysis in which sesquioxide of iron is reported.

Friability.—The friability or brittleness of slags is dependent upon the number, kind, and amount of the bases present. Generally the more siliceous a slag is the tougher it is, and the greater the amount of base the more brittle it is, though the latter statement is subject to certain limitations. Slags not containing over 33 to 34 per cent of silica are usually brittle; whenever the silica runs up to, say, 35 to 40 per cent, we have quite tough slags unless the slag has very little iron and a large amount of lime (say from 22 to 30 per cent). A slag containing 30 per cent SiO_2, 50 per cent FeO, and 3 to 8 per cent CaO, is not very brittle, yet the amount of base is large in comparison with the amount of acid present. Slags of the type 30 per cent SiO_2 + 40 per cent FeO + 20 per cent CaO are always brittle; so also are the slags containing 34 per cent SiO_2 + 34 per cent FeO + 24 per cent CaO.

As an example of tough slags analyses Nos. 18, 32, 36, 40, and 97 may be cited. The following analyses are examples of brittle slags:—Nos. 7, 13, 14, 45, 46, 55, 56, 57, 64, 65, 66, and 67. The most brittle slags I have ever seen are those numbered 64, 65, 66, and 67 in the table of analyses. Whenever the amount of matte produced is quite large it is often best to form a slag which is slightly tough, otherwise there will be difficulty in obtaining a close saving of the matte. If the ores contain much zinc this causes the matte cake to adhere closely to the bottom of the slag cone; in this case it is best not to have the slags too brittle. Generally the brittle slags are freer from both silver and lead. The brittleness is the result of a highly crystalline structure.

Influence of Slow and Rapid Cooling.—The more slowly a newly-drawn pot of slag is cooled, the more perfect will be the crystallisation. Such slowly cooled slags have a certain fixed fusing-point, and are generally only imperfectly soluble in any of the strong mineral acids. This slag, upon breaking open a pot ordinarily, shows a well-defined crystallisation when the type is closely approached, and on the outer edge there will be a thin crust or scale of glassy material. If slags are cooled rapidly the crystallisation will be imperfect, and if very rapidly the structure is entirely changed and often crystallisation is entirely absent. If melted slag is either poured or plunged into water the crystallisation is entirely prevented, and the mass (if not in too large quantities) will show a glassy appearance not unlike that of obsidian. Slags thus rapidly cooled have suffered a very remarkable and hitherto unrecorded change; they will be found to have a much lower fusing-point, and by powdering them they will be found to be entirely soluble in any of the strong acids, especially in hydrochloric acid. By taking advantage of the last-named fact it will be readily seen that fusions for the analysis of slags are entirely unnecessary in connection with this industry.

It is generally customary at lead smelting works to turn a stream of water on the slag trough or "slag runway" soon after tapping a pot of slag, thus chilling and rendering brittle that portion which has adhered to the trough; and this is most always thrown away, injudiciously so it is thought, since this portion will not only contain many matte globules, but also very often pellicles of lead which may have lodged upon the trough either from a "blow-pot" or from a leaky breast. This rapidly cooled slag is not only generally richer, therefore, than the main

body of the slag, but, if for no other reason, it should be saved for these uses: it melts at a very low temperature, and hence is valuable for "blowing-in" a furnace; to be fed after "barring the hangings"; and it also serves a most admirable purpose in keeping down or preventing the so-called "over fire" or "fire tops."

(To be continued.)

VALUATION OF INDIGOES.

AN INVESTIGATION INTO THE VARIOUS METHODS EMPLOYED FOR THE ESTIMATION OF INDIGOTIN, TOGETHER WITH CERTAIN NEW AND MODIFIED PROCESSES.*

By CHRISTOPHER RAWSON, F.C.S.

INDIGO was known in India and Egypt more than two thousand years ago, but was not introduced into Europe for dyeing purposes until the seventeenth century. Notwithstanding the countless numbers of colouring-matters which of late years have found their way into the market, indigo may still be considered the most important of all dyewares. It is not my intention, however, to speak of the dyeing properties of this valuable colouring-matter, nor of its mode of preparation; but I purpose to notice some of the most reliable methods for ascertaining its value.

As this drug varies in value from 1s. to 10s. per lb., it is of the utmost importance to the consumer that he or his chemist should be able (without the expenditure of much time or labour) to determine the exact composition, so far as its tinctorial power is concerned, of a sample of indigo under examination. Many indigo merchants, and others, who have had years of experience in the buying of indigoes, seem to imagine that it is quite possible to form a perfectly accurate estimate of the drug by mere inspection. I am inclined to think there are dyers who hold the same opinion, and who look upon the chemical examination of indigo and other dyewares with a considerable amount of distrust. Although I have often been surprised to find indigo dealers classify their samples with so much accuracy, yet repeated experiments have convinced me that frequently their estimates have been in error to the extent of 3d. to 9d. per lb.

The principal colouring-matter in indigo is indigotin, in addition to which indigo-red, indigo-brown, indigo-gluten, and mineral matter are present. The different shades obtained in the dye-bath by different classes of indigo are, for the most part, due to the relative proportions of indigotin and indigo-red present; the other bodies produce little or no effect. Anyone for the first time wishing to determine the amount of indigotin in a sample of indigo, would probably be bewildered by the numerous processes which he would find had been proposed for attaining that object; and upon consulting different text-books he would also discover that authorities differed very considerably in describing what may be said to be the same process. Many of the methods, copied from one book to another, with or without alteration, are utterly untrustworthy; while others, although fairly accurate, require so much time and attention that for commercial purposes they are out of the question.

In this paper I purpose making the following classification of the methods which I have examined:—

I. Where the indigo is dissolved by means of sulphuric acid.

II. Where the indigotin is estimated by means of sublimation.

III. Where the indigo is reduced to indigo-white in an alkaline solution.

1. *Solution in Sulphuric Acid.*—In the first place it is of course important that the sample taken for analysis should represent as nearly as possible the bulk from which it has been obtained. This is best performed by taking small pieces from each of the lumps in the sample and pounding them together in a mortar. After grinding a portion to an impalpable powder it is passed through a fine sieve, any any particles remaining are returned to the mortar, until the whole is fine enough to pass through the sieve. When carefully worked in this manner I have found, in the great majority of cases, the dock samples to agree remarkably closely with the chests of indigo represented.

Regarding the solubility of indigo in sulphuric acid, writers differ very greatly; not only in respect to temperature and time to which the mixture is to be exposed, but also as to the quantity and strength of acid to be employed. The following receipts for dissolving indigo (which I have copied from well-known text-books) show to what an extent this diversity of opinion prevails:—

(*a*) Digest 1 grm. indigo for some hours at a temperature of 50° to 60° with 10 grms. fuming sulphuric acid.

(*b*) Mix 1 grm. indigo with 12 grms. strongest fuming sulphuric acid; allow to stand for twenty-four hours at a temperature of 20° to 22°.

(*c*) Mix 1 part indigo with 5 parts ordinary sulphuric acid, and keep at a temperature of 40° for ten to twelve hours.

(*d*) Mix 1 part indigo with 20 parts sulphuric acid, and allow to stand twenty-four hours at 30°.

(*e*) Mix 1 part indigo with 15 parts strongest sulphuric acid; and allow to stand three days.

(*f*) For the purpose of dissolving indigo only the strongest fuming sulphuric acid (sp. gr. 1·89 to 1·92) is available.

I have made a number of experiments in order to determine the quickest and best method for rendering indigotin perfectly soluble in sulphuric acid, and have finally adopted the following mode of procedure:—

One grm. of finely powdered indigo is intimately mixed in a small mortar with its own weight of ground glass. The mixture is gradually and carefully added, during constant stirring with a glass rod, to 20 c.c. of concentrated sulphuric acid (sp. gr. 1·845) contained in a cylindrical porcelain crucible (cap. 1½ ozs.); the mortar is rinsed out with a little powdered glass, which is added to the contents of the crucible, and the whole is exposed in a steam oven for a period of one hour to a temperature of 90° C. The sulphindigotic acid thus formed is diluted with water, and made up to 1 litre.

By this mode of treatment experience has shown that all the indigotin is thoroughly dissolved, whilst the filtered solution obtained is freer from foreign bodies than when the methods previously quoted are employed. The following table contains a few of the results obtained in these experiments:—

Time during which the mixture of indigo and sulphuric acid was exposed.	Indigotin.	Percentage of Indigotin by Hyposulphite method.		
	Hyposulphite required by 50 c.c. ind solution—c.c.	Java.	Kurpah.	Madras.
¾ hour at 90° C.	10·2	—	—	37·10
1 hour at 90° C.	10·25	68·50	46·75	37·35
2 hours at 90° C.	—	68·05	—	36·70
3 hours at 90° C.	—	—	—	35·60
24 hours at 15° C.	10·2	68·25	47·10	37·15

The solution of sulphindigotic acid must be filtered in order to separate certain insoluble impurities, which otherwise would interfere with subsequent operations. Pure indigo-blue dissolved in sulphuric acid is, by the action of various oxidising agents, more or less readily converted into a pale yellow body, named sulphisatic acid. The substances which have been most generally used for the purpose of analysis are chlorine, bichromate of potash, and permanganate of potash. Unfortunately all these bodies attack not only the indigotin, but act also

* *Journal of the Society of Dyers and Colourists*, No. 4, Vol. I.

upon the green and brown substances which are present to a greater or less extent in samples of commercial indigoes. When, therefore, an analysis is made by the employment of a standard solution of chlorine, bichromate of potash, or permanganate of potash, the result obtained is always too high, and, as a rule, the poorer the quality of indigo the greater will be the error, on account of the presence of larger quantities of other substances possessing no tinctorial power.

Of all the processes based upon oxidation I consider the "permanganate" method by far the best; and yet I know of no text-book which enters into any details respecting it. The use of bleaching-powder, chlorate of potash, and bichromate of potash requires the solution of indigo to be of such a strength that, in the case of inferior qualities, the end of the reaction is obscured by the dark colour of the liquid.

Many persons who are not well versed in chemical manipulation, or who cannot devote the time to a detailed analysis, may occasionally desire to determine the value of a sample of indigo. In such cases I would strongly recommend the "permanganate" process, in the manner to be now described. About 1 grm. (0·75 to 1·25) of the sample is dissolved in sulphuric acid, as previously stated, diluted to 1 litre, and filtered; 50 c.c. of the filtrate are measured into a porcelain dish, to which are added 250 c.c. of distilled water. To this diluted liquid a solution of permanganate of potash (0·5 grm. per litre) is gradually run in from a burette, until the liquid, which at first takes a greenish tint, changes to a light yellow. With indigotin and the better qualities of indigoes the end of the reaction is remarkably clear and distinct, and even with an inferior "Kurpah" containing much foreign matter it is easy, with a little practice, to obtain results agreeing very closely one with another. According to the equation—

$$5C_8H_5NOSO_3+K_2Mn_2O_8+3H_2SO_4=$$
$$=5C_8H_5NO_2SO_3+K_2SO_4+3H_2O+2MnSO_4,$$

1 molecule of potassium permanganate oxidises 5 molecules of sulphindigotic acid, and consequently 316 parts of potassium permanganate become the measure for 655 parts of indigotin. Although with a strong solution of indigotin the theoretical quantity of permanganate is decolourised, yet I have found, on working with a dilute solution, that the end of the titration is reached by the consumption of a smaller amount of potassium permanganate than is indicated by the above equation. In order to obtain comparative results it is necessary that the solution of indigo should be dilute, in which case the reaction which takes place is not strictly according to the above equation; therefore the strength of the "permanganate" solution should be ascertained by dissolving 0·5 grm. of pure indigotin in sulphuric acid, and treating the solution obtained as previously described. The results obtained by this method are somewhat too high, yet they give one a fairly approximate idea of the relative values of different samples under examination.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, December 15th, 1887.

Mr. William Crookes, F.R.S., President, in the Chair.

(Concluded from p. 277).

99. "*Isomeric Change in the Naphthalene Series.*" No. 1. By Henry E. Armstrong.

It having been ascertained that betanaphthylsulphate, $C_{10}H_7\cdot OSO_3H$, may be converted by mere warming in the water-bath into the isomeric betanaphtholsulphonic acid (Schaefer's modification), the study of the conditions under which isomeric change occurs in the case of naphthalene-derivatives became of special importance in determining the laws which govern substitution in the naphthalene series, and indeed generally. Experiment soon showed that there were important differences to be observed: thus bromobetanaphthol gave but little sulphate, being almost entirely—and *apparently* directly—converted into the isomeric acid which may be prepared by brominating Schaefer's betanaphtholsulphonic acid; in like manner, betanaphthylsulphate when sulphonated by chlorosulphonic acid does not yield, as might have been expected, a sulphosulphate, but an isomeric disulphonic acid. This latter acid is of special interest on account of the readiness with which, by mere warming with dilute sulphuric acid, it is converted into Schaefer's betanaphtholmonosulphonic acid: there is little doubt that one of the sulphonic groups occupies an alpha-position contiguous to the OH, and hence the readiness with which it is displaced by hydrogen. These observations have not only led to the experiments being made of which the results are described in the following notes, but they have served in connexion with the observations on the sulphonation of naphthalene to favour the assumption that the action of sulphuric acid is in the majority of cases of a very simple character, and that when isomers are produced, their formation is very frequently the outcome of isomeric change. The author proposes to pay special attention to the investigation of this question, and not only in the naphthalene series.

100. "*Isomeric Change in the Naphthalene Series.* No. 2. *β-Ethoxynaphthalenesulphonic Acids.*" By E. G. Amphlett and Henry E. Armstrong.

In order to determine the course of chemical change when the formation of the sulphate is prevented, the authors have sulphonated by means of chlorosulphonic acid the ethoxynaphthalene, $C_{10}H_7\cdot OC_2H_5$, prepared by ethylating betanaphthol. The product obtained when a cold solution in carbon bisulphide is operated upon is a mixture of two sulphonic acids, one of which is undoubtedly derived from Schaefer's modification of betanaphtholsulphonic acid, and the other probably from Baeyer's modification; if the product be heated in the water-bath, the latter acid is converted by isomeric change into the former.

The two acids are readily distinguished by means of their barium salts: that of the former acid being almost insoluble in water, while that of the latter dissolves easily and crystallises in transparent prisms containing $3H_2O$. On submitting the difficultly soluble potassium salt from the former acid to the action of bromine, a difficultly soluble ethoxybromosulphonate is obtained; and on further treatment with bromine the bromhydroxyquinonesulphonate is produced which may be prepared in a similar manner from Schaefer's acid. Altogether different results are obtained on heating the isomeric ethoxyacid with bromine. Experiments are in progress with other derivatives of both α- and β-naphthol in which the hydroxylic hydrogen is displaced by positive and negative radicles.

101. "*Isomeric Change in the Naphthalene Series.* No. 3. *β-Chloronaphthalenesulphonic Acids.*" By Henry E. Armstrong and W. P. Wynne.

The authors have previously shown that when β-chloronaphthalene is sulphonated by means of chlorosulphonic acid, the product consists of the two isomeric monosulphonic acids which Arnell obtained by using fuming sulphuric acid: one of these is the $\beta^2\beta^{3'}$-derivative corresponding to Schaefer's betanaphtholsulphonic acid, and it was of importance to determine whether this acid was a primary product of sulphonation or a product of isomeric change. It is found that a small proportion—very few per cent—of the $\beta^2\beta^{3'}$ acid is formed even when the sulphonation is effected by adding the chlorosulphonic acid to a cold solution of β-chloronaphthalene in carbon

bisulphide, and that heating on a water-bath has little or no effect; but that if the product be heated to a temperature at which it is just fused—about 150°—for an hour, an appreciably larger proportion of the $\beta^2\beta^{3'}$ acid is obtained, and that after heating for five hours at 150° the product chiefly consists of this acid. There can be little doubt therefore that the $\beta^2\beta^{3'}$ acid is a product of isomeric change.

102. "*Isomeric Change in the Naphthalene Series.* No. 4. *α-Haloidnaphthalenesulphonic Acids.*" By Henry E. Armstrong and S. Williamson.

The authors have previously shown that when α-chloro, or α-bromonaphthalene is sulphonated by means of chlorosulphonic acid the product mainly consists of the 1 : 4-derivative together with a very small proportion of what is probably the 1 : 2-derivative. They now find that if the product be heated at 150°, isomeric change takes place, new acids being formed of which the constitution has yet to be determined.

It has been stated by Gessner that when potassium α-bromonaphthalenesulphonate is heated with PCl_5 it is converted into a chloronaphthalenesulphobromide melting at 115°. The authors have obtained the normal product, bromonaphthalenesulphochloride, which melts at 101°; but on heating potassium chloronaphthalenesulphonate with PBr_5, they obtained a substance precisely like that described by Gessner and which gave similar results on analysis: this, however, they find is a mixture or compound of chloronaphthalenesulphobromide and bromonaphthalenesulphochloride, and they are inclined to attribute its formation to the presence of free bromine in the PBr_5, and that of Gessner's product to free chlorine in the PCl_5 used by him.

Jolin's statements regarding the properties of bromonaphthalenesulphonic acid, which do not accord with their own, are no longer surprising now that the occurrence of isomeric change on heating is established; the authors have moreover observed that when bromonaphthalene is heated with excess of sulphuric acid the bromine is displaced, a naphthalenedisulphonic acid being formed; it is not improbable that the dibromonaphthalene melting at about 160° which Jolin obtained was formed from a naphthalenedisulphonic acid.

103. "*The Sulphonation of Naphthalene.*" By Henry E. Armstrong and W. P. Wynne.

After a very careful study of the products of the direct sulphonation of naphthalene and of the naphthalenemonosulphonic acids by means of chlorosulphonic acid, the authors are convinced that the initial action is always of a simple character and takes place in accordance with what one of them has termed the alpha-law; and as they have also failed to obtain any evidence of the occurrence of isomeric change in the case of the sulphonic acids, they are of opinion that the formation of β-sulphonic acids is due to secondary change, and probably involves the formation and subsequent partial hydrolysis of a higher sulphonic acid than that which is eventually separated. Thus they find that naphthalene may be almost entirely converted into the α-monosulphonic acid by careful treatment with a single molecular proportion of chlorosulphonic acid, and that the sole product of the action of 2 mol. props. is the $\alpha'\alpha^{4'}$ or γ-disulphonic acid; the pure β-monosulphonic acid in like manner yields as sole product the β(?)-disulphonic acid previously described by them, which is undoubtedly an α-β-derivative—in all probability the 2 : 4′ modification. By heating naphthalene with a considerable excess of chlorosulphonic acid at about 150°, they have obtained a trisulphonic acid. This acid yields a very soluble lead salt. Its sodium salt crystallises in aggregates of very slender needles of the composition $C_{10}H_5(SO_3Na)_3{\cdot}5H_2O$; its sulpho-chloride melts at 194°. Experiments are in progress to determine the nature of the trisulphonic acids formed in a similar manner from the β (?) and Ebert and Merz's two disulphonic acids.

To determine whether the sulphonic acids undergo isomeric change, an aqueous solution of the β (?)-disulphonic acid was heated in an air current at a temperature gradually rising to 170—180°, at which it was maintained for several hours: much naphthalene sublimed, and the residue was found to consist almost entirely of the β-monosulphonic acid. Ebert's and Merz's α-disulphonic acid treated similarly underwent no change. On evaporating the water from a solution of α-monosulphonic acid as far as possible at 100° and then raising the temperature to 115°, hydrolysis immediately sets in.

NOTICES OF BOOKS.

Sewage Treatment, Purification, and Irrigation. A Practical Manual for the use of Corporations, Local Boards, Medical Officers of Health, Inspectors of Nuisances, Chemists, Manufacturers, Riparian Owners, Engineers, and Ratepayers. By J. W. Slater, F.E.S. London: Whittaker and Co., and G. Bell and Sons.

We have had a sufficiency—or something more—of patents for dealing with sewage, of reports, papers, and acrimonious discussions on this vexed and fertile subject. Now, by way of variety, we have a practical, sober manual for treating this troublesome waste product of human life. The author—a man of long and wide experience—has, we must admit, no *system*. There is no one process which he recommends as universally applicable. His preference is evidently awarded to "precipitation *plus* absorption," that is the use of a suitable metallic precipitant in conjunction with some absorbing or occluding agent, such as clay, earth, carbonaceous matters, &c. This process, he shows, involves "inverse irrigation," as by it the sewage is not passed through the land, but the land, or its equivalent, through the sewage. Irrigation he considers an excellent method of disposing of and utilising sewage where the conditions are favourable, but he is not blind to its defects, and condemns the "attempt to represent it as the only means of dealing with the sewage difficulty." It is liable to encourage dipterous insects, which, on the evidence of Grassi, Daraine, Manson, Maddox, and others, the author shows to be agents, perhaps *the* agents, in the diffusion of zymotic disease.

A strong point in favour of irrigation from the economical point of view is here brought forward—the successful conversion of Italian rye-grass into hay.

The Bazalgette system and the scheme for deodorising sewage without previous precipitation or irrigation are condemned. Perhaps the author would have expressed himself more forcibly on the latter scheme had he met with the recent report of the Medical Officer of Health for the Port of London. This gentleman, whose duties must involve a thorough acquaintance with the condition of the river, declares that during last summer its state between Greenwich and Erith was abominable, amost beyond description.

Filtration as a substantive process the author considers applicable only if the sewage contains matter injurious to crops and to the land, a state of things, we must add, by no means uncommon in our own great manufacturing towns.

Among precipitation processes he disapproves of all in which lime figures, not merely for neutralising possible acids, but as a substantive agent, thus rendering the effluent water alkaline. He utterly rejects salts of tin, lead, zinc, and barium. He gives the preference to salts aluminium, especially the basic sulphates and the chloride, to soluble aluminates, and silicates. The practical instructions for conducting precipitation, for arranging tanks, for judging of the degree of purification effected, &c., show close observation, and will prove exceedingly useful.

Under "Promiscuous Methods" we find mention of the "Metropolitan System," in which sewage is first to

be slightly precipitated with lime and copperas, the effluent then deodorised with sodium permanganate and sulphuric acid, then aërated, and the deposit lastly put on board ship and sunk in the North Sea. This process, the author tells us, is like Dr. Abernethy's celebrated receipt for dressing cucumbers, and he reminds us that here "the entire expenditure is incurred in pure waste, no value being recovered from the sewage."

For Royal Commissioners the author does not entertain any profound respect, considering that they are prone to ignore any evidence which does not seem likely to support their own prepossessions. As a matter of course, the "Recommendations" of the late "Royal Rivers Pollution Commission" are weighed and pronounced wanting on grounds substantially agreeing with those which have been urged from time to time in the Chemical News. He points out especially the very easy manner in which all restrictions may be evaded which are founded merely on the quality of waters discharged into a river without regard to their quantity.

As regards sewage legislation, he points out two glaring defects in the Act of 1876, now in force, and in the Bill brought in by Earl Percy, Col. Walrond, and Mr. Hastings. These defects are that neither of the measures attempted a codification of the law on the pollution of rivers, and that they provided no remedy for the contamination of underground waters.

To persons who are candidly seeking the solution of the sewage question, this book will be welcome and useful. But there are, we fear, quarters in which it will meet with a very hostile reception.

Foods: Their Composition and Analysis. A Manual for the use of Analytical Chemists and Others. With an Introductory Essay on the History of Adulterations. By A. Wynter Blyth, M.R.C.S., F.C.S., &c. Third Edition. London: C. Griffin and Co.

We have here an encyclopœdia of adulterations and the methods for their detection on a level with the requirements of the day. From Accum's "Death in the Pot," and even from the "Report of the *Lancet* Analytical Commission" to the work before us, there is indeed a change for the better. Vague, hearsay statements as to prevalent sophistications have given place to precise information, based upon actual determinations. Doubtful analytical methods have been set aside, and in their place have come more trustworthy procedures. Meantime the enemy has not been standing idle. New frauds have been devised as old tricks became exposed, and it would be idle to say that the difficulties of detection have not in some cases been increased.

The introductory portion of the work is exceedingly valuable. It gives an account of the existing state of the law on adulteration, with abstracts of cases and judicial systems. We regret that we find here no notice of the ultimate result of the case where a town councillor added a poison to a sample after purchase, but before sending it to the borough analyst. As to the thorough amendment which the statutes bearing on adulteration require, we fear it is, under the English system of "government by party," out of the question.

The work before us, however, is by no means limited to the consideration of frauds. The author, for instance, treats at length on the analysis of water, the undesirable matters often found in which are certainly not due to the intentional addition of any substance whatever. Milk and cheese may be rendered dangerous by disease, improper diet, or by subsequent decompositions. On this subject we find a passage in which we cannot agree with Mr. Wynter Blyth's reasoning. He writes:—"Mr. A. H. Smee has also stated that the milk of cows fed on sewage (irrigation) farms rapidly putrefies, but no details are given as to the manner in which the samples were collected, and the explanation may be that the putridity of the milk was not due to the grass eaten, but that the teats of the cow were fouled by decomposing substances which would mix with the milk and infect it." We cannot accept this explanation. Mr. A. H. Smee's experiments were comparative: one cow was fed on sewage-grass and one on normal grass, the diet of the two being afterwards reversed. In the absence of direct evidence to the contrary, we are bound to assume that both cows were milked with the same precaution or want of precaution. It cannot be supposed that in every case the cow fed on sewage grass had her teats fouled whilst those of the other fed on normal grass remained clean! Even if we suppose that the cow feeding on sewage grass had the opportunity of fouling her teats with her food (which by no means follows) the sewage grass is not exculpated, since we may be sure that at an irrigation farm the teats of the cows will not be carefully washed and disinfected before milking.

As regards the analysis of milk, the author states that, though some partial modifications have been introduced, the general process is still that of Mr. Wanklyn. Among the modifications is the determination of fat. According to the method proposed by Dr. Adams, this constituent comes out about 0·5 per cent higher than by the Wanklyn process. This, of course, brings the total quantity of "solids not fat" proportionately lower. "Milk sugar," we read, "so far as is known, is only found in human milk, the milk of the herbivora, and of the bitch." This statement does not agree with the analysis of the milk of the sow, which, according to Kœnig, contains, as given below, 3·13 per cent of sugar.

The part played by milk in the distribution of scarlet fever is admitted as established. The alleged adulteration of milk with the brains of horses is rightly set aside as mythological. The addition of antiseptics to milk is condemned. They can have no effect in destroying the germs of any disease communicable to man, and by their use cleanliness in the dairy would not be regarded so essential as it is at present.

It appears that arsenical washes have been applied to the rind of cheese to prevent the attacks of flies, and in a few cases—one so late as 1854—arsenic has been mixed with the cheese itself as a preservative.

In speaking of sugar the author gives no indications for discriminating beet-sugar from cane-sugar. Bees can distinguish them, and we hear practical men in the sugar trade who can do the same, however the samples may be refined.

In discussing water the author remarks that, "in England, although foxes may be dug out to be eaten alive by hounds, and rat-catchers may poison rats by the gross, scientific men are unable, save under practically prohibitory restrictions, to advance biological science by the use of life itself as a reagent for obscure poisons." He scarcely brings into view the full inconsistency and absurdity of the law. A man may poison wild animals in any number to get rid of them, or simply for amusement, or for a wager. But the moment he seeks to derive any instruction from their death he is liable to fine and imprisonment.

To call attention to everything in this closely-printed volume which might justify notice—for the most part of an approving character—is plainly beyond our power. So we must content ourselves with pronouncing it a storehouse of valuable information and trustworthy guide for the analyst in a very difficult and onerous department of his profession.

A Manual of the Manufacture of Gas from Tar, Oil, and other Liquid Hydrocarbons, and Extracting Oil from Sewage Sludge. By W. Burns, C.E. London and New York: E. and F. N. Spon.

From the preface to this book and from certain passages which we meet with here and there, the author seems to have had what in America would be called a "difficulty"

with the *Journal of Gaslighting*. Into the details of this grievance we cannot enter, from the sufficient reason that, save from the passages which Mr. Burns quotes, we do not know what the *Journal of Gaslighting* has said. An apparatus is here described as capable of producing 14-candle gas at 2d. per thousand, "perfectly free from sulphur and ammonia impurities." The raw material is tar. We find it stated that "a mixture of coal and wood tar gives a larger proportion of essential vapour than either of these tars does when distilled alone, and . . . when coal and wood tar is mixed with animal oil and distilled by the method above described it will produce a superior illuminating gas."

It is, of course, impossible to test these statements except by practical working on a fair scale. But if Mr. Burns can really produce such gas as he described at 2d. per 1000, we should think that he will not need to wait long for the opportunity of making good his claims.

The "Cumulative Piston Retort," an apparatus here described and figured, seems applicable to a number of important purposes. The author enumerates the manufacture of coke, the tar and ammonia being likewise utilised; the distillation of sawdust, peat, &c., for the production of tar and acetic acid; the treatment of pyrites, either for obtaining sublimed sulphur or for the manufacture of sulphuric acid; the distillation of lime and cement; the production of salt-cake and hydrochloric acid (the first stage of the Leblanc alkali process), and the conversion of the salt-cake into black-ash. Here it is said that the ordinary mixture of salt-cake, limestone, and ground coal, if furnaced in these retorts, instead of producing calcium sulphide, as in the reverberatories, sulphuretted hydrogen is generated, from which it is proposed to recover the sulphur.

Another suggested application is the extraction of oil from the press-cake of olives.

Concening all these processes, we can only repeat what we have in substance already remarked, that if the "cumulative piston retort" can do any of these things better than they are done already, it has a great future. But here experience alone can decide.

Meantime we cannot accept the statement of Mr. Burns, that the utilisation of sewage sludge is a problem not yet solved, and that all the schemes to convert it into a portable manure have failed. A manure containing nitrogen equal to 3 per cent of ammonia, and phosphoric acid equal to 5 per cent of tricalcic phosphate, and which in practice gives better results than its analytical composition would lead farmers to expect, cannot be called unsatisfactory.

Nor is the drying of the sludge necessarily attended with "ruinous expense." When it is spread out in thin layers it dries, not so much, as Mr. Burns thinks, by evaportion from the surface, as by absorption downwards and laterally, if the soil is suitable.

The Students' Hand Book of Chemistry, with Tables and Chemical Calculations. By H Leicester Greville, F.C.S., F.I.C. Second Edition. Edinburgh: E. and S. Livingstone.

The rush of elementary treatises on chemistry, which has for some time subsided, seems to be again on the increase. A friend ot ours asks if, like seasons of bad trade, political excitement, and epidemics, the appearance of such books might not be brought in connection with the periodicity of sun-spots? The work before us, however, may claim some very decided merits. In the first place, it contains no reference to examinations and no collection of papers set by any degree-granting body. We may venture to say that the author's primary object is to enable the student not so much to "pass" as to "know." His account of the periodic law is sound, and, giving honour where honour is due, he recognises Mr. Newlands as the initiator of the system which Mendeleeff and Meyer have since further developed. He has appended to his treatise a very useful glossary or collection of definitions of the principal terms used in chemistry.

On the other hand we must notice a peculiar and scarcely justifiable classification of the elements into "non-metals, metalloids, and metals." Here the term metalloid is used, not as it is often done, *e.g.*, by French chemists for the non-metallic elements, but for some simple bodies, "which from physically resembling metals while chemically they have greater analogy to the non-metals, occupy a sort of border line between the two classes." This, we submit, is likely to occasion confusion.

In the theoretical chapters of the book we find no reference to thermo-chemistry, a subject which in these days cannot justly be overlooked.

The aniline colours occupy but little space, and we are surprised to find *mauve* spoken of as a "commercial colour" and as "one of the most important aniline dyes." Surely the author must be well aware that the importance of this substance is purely historical, and that it has disappeared from the market. We also regret to find the alien word "fuchsine" given as a name for the rosaniline reds.

Taken as a whole, however, the work before us must decidedly rank among the preferable class of chemical manuals.

A few errors, clerical or typographical, deserve notice. We read here of "mythyl," "ormipent," "baisicity," and we find a promiscuous use of such orthographies as gelatin and gelatine, sulphocyanate and sulphocyanide.

Genealogical Tree of Coal-tar Products. By B. Vickers, F.C.S. Published by Bemrose and Sons, London and Derby, for Messrs. Lawton and Co., of Birmingham and Bradford.

We have here an original publication. The coal-tar products are shown in the form of a genealogical tree. The trunk of the tree is, of course, coal-tar. The branches shooting out to the right in ascending order are: Ammonical gas-liquor, carbolic oils, with some naphthalene, and heavy oils, the main twig of the latter being, of course, anthracene. To the left hand shoot out two mighty boughs; first runnings and light oils, and higher up creosote oils and naphthalene. All the sprays representing tinctorial compounds are coloured blue, green, red, yellow, &c., as the case may be. We think that this graphic representation of the connection and descent, so to speak, of the coal-tar products will prove a boon at once to teachers and students.

CORRESPONDENCE.

ANALYSES OF MIXED PAINTS.

To the Editor of the Chemical News.

Sir,—The answer to "R. S." on the analysis of mixed paints give by Mr. Thomas T. P. Bruce Warren if acted upon is likely to cause serious errors in such analyses. Paints containing metallic compounds, *i.e.*, oxides, carbonates, sulphides, and hydrates, when ground in linseed oil, undergo decomposition, oxyoleates of the metal being formed.

These oxyoleates are readily soluble in the solvents mentioned by Mr. Warren. Oil therefore extracted by his process would appear much above the truth, and the metal contained in the paint free from "oil" would be correspondingly low. Of course if the oil extracted with disulphide be burnt off, the metal will be left, and may be determined. But Mr. Warren objects to burning the oil.

Mixed paints, extracted in the same way, would give the same errors. In addition, Mr. Thomas T. P. Bruce Warren makes it appear that the oil and turpentine, shale

spirit, or petroleum, may be extracted with disulphide or with *petroleum spirit*, the sovlent then evaporated, the weight of linseed oil, boiled oil, resinous matter, &c., turpentine, *shale spirit* or *petroleum* is obtained! It is obvious that the turpentine, shale spirit, or petroleum would evaporate with the solvent used for their extraction, leaving nothing but the error introduced by precipitating the oil by means of chloride of sulphur to represent them.

Mr. Thomas T. P. Bruce Warren also states that "resin if present may be extracted by alcohol from the *matter removed by disulphide. Alcoholic solution of soda* in some cases is necessary for this purpose." An alcoholic solution of soda would certainly remove oil as well as resin.

The oil is not the "body" giving material of paints, the "body" being in the pigment. No amount of oil and turpentine added to sulphate of barium, for instance, would give it a "body."

I find that in making analyses of mixed paints it is best to decompose right off with nitric and hydrochloric acid, or with nitric alone when circumstances render the use of hydrochloric undesirable, taking the acid almost to dryness. This decomposes all the metallic soaps in the paint. The acid solution is filtered when the oil is retained on the filter with any insoluble matter, and is readily burnt off.

If an examination of the oil is desired, some of the paint is shaken up with ether, allowed to settle, the ethereal solution run off and evaporated, when the nature of the residue may be examined.

Petroleum or turpentine in mixed paints should be separated by distillation, and the oil in all cases be determined "by difference."—I am, &c.,

William Fox.

Laboratory, 4, Great Tower Street, E.C.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cv., No. 23, December 5, 1887.

The Expansion of Compressed Liquids, and in particular the Expansion of Water.—E. H. Amagat.—The author has studied, between 0° and 50° and from the normal pressure up to 3000 atmospheres, the compressibility and the expansion of water, common ether, the methylic, ethylic, propylic, and allylic alcohols, acetone, ethyl chloride, bromide, and iodide, carbon disulphide, and phosphorus chloride. Setting aside water the coefficient of expansion of other liquors decreases as the pressure augments. This decrease is less and less marked, but at 3000 atmospheres it is still very distinct. Under the normal pressure the coefficient augments with temperature; this variation also decreases progressively as the pressure increases. The coefficient of water increases at first very rapidly with the pressure; this increase goes on decreasing, and disappears about 2500 atmospheres.

A New Method of Determining Carbonic Acid in Solution.—Leo Vignon.—The coloured liquid produced by mixing 50 c.c. of lime water and 10 drops of a saturated solution of pure phenolphthalein is very rapidly decolourised by the addition of a sufficient quantity of an aqueous solution of carbonic acid free or combined with neutral calcium carbonate. Hence it results that carbonic acid in a free or a semi-combined state may be determined volumetrically by saturation with a standard solution of calcium hydroxide, using phenol-phthalein as indicator.

Justig Liebig's Annalen der Chemie. Vol. ccxxxix., Part 3.

Communications from the Chemical and Pharmaceutical Laboratory of the Technical High School at Brunswick.—Comprise papers by R. Otto on β-dichlorpropionic acid and by the same author on the synthesis of xeronic acid from α-dibrom normal butyric acid.

Contributions from the Chemical Institute of the University of Bonn.—These include a memoir on antimony pentachloride, by R. Anschütz and N. P. Evans; on the action of phosphorus pentachloride upon chloralide, by R. Anschütz and N. P. Haslam; the action of phosphorus trichloride upon salicylic acid and phenol, by R. Anschütz and W. O. Emery; the action of phosphorus pentachloride upon salicylic acid, by R. Anschütz and G. D. Moore, and the action of phosphorus pentachloride upon meta- and para-oxybenzoic acids, by the same authors.

The Colour-Bases from Furfurol.—Hugo Schiff.—In this second treatise is described β-furonaphthyline, the furopolyamines, dimethyl-furaniline, the furfurol bases with mixed amines, the furfuramidic acids, furopicramic acid, the constitution of the chromogenous furfurol bases. He then gives an account of experiments with furfur-alcohol, the behaviour of furfurol with phosphorus chloride, and the reactions of furfurol. In an appendix are described the derivative bases of cinnamic aldehyd.

Constitution of Propio-propionic Ether.—A. Geuther.—This ether is distinguished from acet-acetic ether by the fact that when mixed with sodium alcoholate and treated with ethyl iodide it yields, not ethyl propio-propionic ether, but propionic ether and ethyl-propionic ether.

Revue Universelle des Mines et de la Metallurgie. Vol. xxii., No. 1, July and August, 1887.

New Volumetric Process for Determining the Grey Zinc Powder of Vieille Montagne.—F. Weil.—On treating a given quantity of zinc-powder with an excess of a neutralised solution of copper, of a known strength, the metallic zinc contained in the sample precipitates copper, equivalent for equivalent. On then titrating the excess of copper remaining in solution with stannous chloride the difference between this quantity and the total copper employed indicates the copper precipitated by the zinc. If this amount is then multiplied by 1·0236, we have the quantity of pure zinc contained in the sample.

Process for Increasing the Value of the Phosphoric Acid in Thomas and Gilchrist Slags.—H. Bya.—L. Blum has patented a process for obtaining soluble phosphate by substituting soda for the lime used in the flux.

Bulletin de la Société d'Encouragement. Series 4, Vol. ii., No. 20, August, 1887.

Report presented by M. Le Chatelier on Behalf of the Committee of Chemical Arts on a Novel Alloy of Aluminium submitted by M. Bourbouze.—The alloy consists of aluminium and tin. If there is only 10 per cent of the latter metal the product is capable of being soldered whilst it retains the useful properties of pure aluminium.

On Beer-Yeast.—E. Ch. Hansen.—This lecture requires the accompanying illustration.

No. 22, October, 1887.

New Method for Distinguishing Animal from Vegetable Fibres.—The reaction utilised is that of α-naphthol with sugars or carbohydrates in general in presence of sulphuric acid, when an intense violet colouration is obtained, or, on dilution with water, a violet precipitate. The following is the most convenient process:—

0·01 grm. of the fibres, previously well-boiled in water to remove dressings, &c., is placed in a test-tube with 1 c.c. of water. Two drops of an alcoholic solution of α-naphthol at 15 to 20 per cent are then added, and a quantity of concentrated sulphuric acid equal in volume to the entire liquid. If the fibre is of a vegetable nature the liquid takes, on stirring, a deep violet colour, and the fibre dissolves completely. If the fibre is of animal origin the liquid takes a yellow or reddish-brown tint, more or less decided. If thymol is used instead of naphthol the colour is scarlet, passing into carmine on dilution with water.

Journal fur Praktische Chemie.
New Series, Vol. xxxv., Part 10.

Contributions to a Knowledge of the Aromatic Ketones.—Karl Ebs.—In this second communication the author examines benzophenone, tolyl-phenyl-ketone, ditolyl-ketone, ortho-xylyl-phenyl-ketone, the corresponding meta- and para-compounds, dipara-xylyl-ketone, mesityl-phenyl-ketone, pseudo-cumyl-phenyl-ketone, paracymyl-phenyl-ketone, α-naphthyl-phenyl-ketone.

Behaviour of Oxalic Ether with Resorcine.—Arthur Michael.—The author examines whether the similarity between sodium acetacetic ether and mixtures of other ethers (which do not form sodium derivatives) with sodium ethylate will appear also in its behaviour with phenols, and to this end he has made experiments with oxalic ether and resorcine.

MISCELLANEOUS.

Compressibility of the Watery Solution of Ethylamine.—F. Isambert.—Ethylamine in a watery solution behaves like ammonia; the coefficient of compressibility of this liquid decreases rapidly in consequence of the addition of water, so as to become lower than that of water. Here, as in the case of ammonia, but in a more decided degree, there is a formation, not of mere mixtures, but of true chemical combinations.—*Comptes Rendus*, Vol. cv., No. 24.

Detection of Aldehyds in the Alcohols of Commerce.—U. Gayon.—The author uses a well-known reaction, the rose-violet colouration given by the aldehyds and acetones in a solution of magenta previously decolourised by means of sulphurous acid. The reagent is prepared by mixing in succession—

Aqueous solution of magenta at 1-10th per cent	1000 c.c.
Sodium bisulphite at 30° B.	20 ,,
Hydrochloric acid, pure and strong ..	10 ,,

The bisulphite is passed into the solution of magenta, and then in about an hour the hydrochloric acid is added. The liquid is preserved in well-stoppered bottles. To make the assay the sample is let down with distilled water to about 50 per cent, and 2 c.c. of this dilute alcohol are then mixed in a test-tube with 1 c.c. of the reagent. The whole is shaken up and allowed to stand. If the alcohol is free from aldehyds the mixture remains colourless. Otherwise it turns a rose-violet, the deeper in proportion as the quantity of aldehyd is greater.—*Comptes Rendus*, Vol. cv., No. 24.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened or the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Glue.—Wanted to know of a cheap glue which, when set, will withstand moderate heat (120° F.) and moisture. Or of any books in which information on the same may be got at.—J. H. B.

Bell Scholarship.—I shall esteem it a great favour if you will let me know what subjects (ordinary and principal) have to be studied in order to acquire a Bell Scholarship in chemistry, and of whom I could procure printed instructions, for a youth's guidance.—INQUIRER.

To Remove Stains of Printing Ink.—Place a thick pad of white blotting-paper beneath the sheet of paper which is thus soiled. Then apply sulphuric ether (methylated will be the cheapest) with cotton-wool, gently rubbing. Then apply white blotting-paper to absorb the colour. Apply fresh ether, and repeat until all stains disappear. Do this away from a light.—G. A. KEYWORTH.

MEETINGS FOR THE WEEK.

MONDAY, 9th.—Medical, 8.30.
TUESDAY, 10th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Photographic, 8.
WEDNESDAY, 11th.—Geological, 8.
—— Microscopical, 8.
THURSDAY, 12th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Mathematical, 8.
—— Telegraphic Engineers, 8.
FRIDAY, 13th.—Quekett Club, 8.
—— Astronomical, 8.

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BOROUGH OF BIRMINGHAM.
GAS DEPARTMENT.

The Gas Committee of the Corporation of BIRMINGHAM are prepared to receive Tenders for the Tar to be produced at their various Works from the 30th of June next, for a period of one or two years, or for one year and then subject to termination of the contract on three months' notice on either side.

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EDWIN SMITH, Secretary.

Borough Gas Office, Council House,
Birmingham, December 31, 1887.

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Telegrams, "Firebrick," Leeds.

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THE CHEMICAL NEWS.

VOL. LVII No. 1468.

EXTENSION OF TIME OF CULTURE IN DR. R. KOCH'S BACTERIOLOGICAL WATER-TEST BY PARTIAL STERILISATION, WITH SPECIAL REFERENCE TO THE METROPOLITAN WATER-SUPPLY.

By GUSTAV BISCHOF, F.C.S., F.I.C.

THE author points out that a source of error in Dr. Koch's biological water-test is due to the interference of certain colonies (those capable of liquefying gelatin) with the culture of other colonies. This interference is the chief obstacle which limits cultures to three days. To render an extension of time possible he endeavours to check the encroaching colonies by means of antiseptics. This he has effected by the use of spongy iron and of permanganate. He raises certain unsolved questions, showing that some microbia require weeks for their development, or may be incapable of growing in gelatin-peptone. He thinks it impossible to decide after three days' culture that no hurtful microphytes are present. He infers from his experiments that no bacteriological water-test can satisfy the demands of hygiene unless it is qualitative, distinguishing between harmless and pathogenic microbia. But no such test is at present known. Without such distinction merely numerical results are of little value. A small portion only of the colonies capable of growing in gelatin peptone is indicated by three days' culture. The ratio of colonies thus indicated by three days' culture to that of the total present appears to differ so widely in different samples that the number of colonies obtained from them cannot be compared with each other. Extension of culture beyond three days increases the reliability of the results, but how far this holds good and how far culture should be prolonged we have at present not sufficient evidence to decide.

These views will, we believe, meet with very general approval among chemists, who are concerned in the examination of potable waters.

METHOD FOR THE VOLUMETRIC DETERMINATION OF SOLUBLE PHOSPHORIC ACID IN SUPERPHOSPHATES.

By A. EMMERLING.

IF we add soda-lye to a solution of superphosphate previously mixed with an excess of calcium chloride, the phosphoric acid is almost entirely precipitated as tricalcium phosphate, one molecule P_2O_5 requiring 4 mols. NaOH.

In this manner the amount of phosphoric acid in aqueous solutions of superphosphate may be determined by titration with soda-lye, but the free phosphoric acid present must be ascertained by a further experiment. This is effected by titrating the superphosphate solution with soda-lye, employing methyl-orange as indicator. This method has the advantage that the change of colour from violet-red to yellow or orange-yellow takes place at the instant when the free phosphoric acid passes into sodium monophosphate. If, then, the c.c. of soda-lye used in this titration are deducted from those consumed in the former experiment, a figure is obtained from which the amount of soluble phosphoric acid in the superphosphate can be calculated according to the proportion 4 mols. NaOH to 1 mol. P_2O_5.

Emmerling allows the solution of superphosphate, mixed with calcium chloride, to flow into a given quantity of soda-lye coloured with phenol-phthalein, and takes the disappearance of the colour as the end of the reaction.

The following solutions are requisite :—

1. A soda-lye of which 1 c.c. indicates about 0 005 grm. P_2O_5 calculated according to the above proportion. The standardising of the soda-lye is effected simply by titration with normal acid, using the same quantity of solution of phenol-phthalein solution (2 c.c.) which serves for titrating the phosphoric acid. Or the soda-lye may be standardised by a faintly acid solution of calcium monophosphate of known value.

2. A calcium chloride solution prepared by dissolving 200 grms. pure dry calcium chloride in 1 litre water. The solution reacts faintly acid, and must be carefully neutralised before use. This is best effected by titrating 100 c.c. of the solution with normal acid and neutralising the remaining 900 c.c. accordingly.

3. Phenol-phthalein, 1 part dissolved in 500 parts of alcohol, as indicator.

4. Methyl orange as indicator. A small quantity is dissolved in water until the quantity appears of a deep orange-yellow and the solution is then filtered.

The execution of an analysis is as follows :—

200 c.c. of the solution of the sample prepared in the ordinary manner are mixed with 50 c.c. solution of calcium chloride and well mixed. One burette is filled with this mixed solution and a second with soda-lye. Of this latter 20, 10, or 5 c.c. (according to the strength of the superphosphate) are measured into a beaker; 2 c.c. of the phenol-phthalein solution are added, and some water and superphosphate solution is then run in rather rapidly. As soon as the colour begins to grow faint the superphosphate liquor is added more gradually, and at last drop by drop, until the redness has entirely disappeared. The recognition of the concluding point, however, requires some experience. As it is necessary to use a large quantity of the indicator the change of colour is not instantaneous, and the reaction is not complete until the last trace of a reddish tone has entirely disappeared, and there appears in its stead a whitish, faintly brown, or yellowish colouration. A re-appearance of redness need not be regarded unless it ensues very quickly and decidedly. Frothing renders the recognition of the change more difficult, whence it should be avoided as far as possible. The determination should then be repeated, advancing more rapidly towards the point of saturation.

He next measures off again the same number of c.c. of the mixed solution of superphosphate and calcium chloride as used above, dilutes with a little water and mixes with 4 to 6 drops of the methyl-orange solution, so that a distinct violet-red colour is produced by the free acid. The liquid is titrated cautiously with the soda-lye, finally drop by drop until the reddish colour changes to a yellow or orange-yellow. Here also the recognition of the final point requires a little practice; the change is more distinct if the liquid has a moderate colouration. After this experiment also has been repeated the smaller number of c.c. of soda-lye, as consumed in the titration with methyl-orange, is deducted from the number obtained on titrating with phenol-phthalein. Thus is obtained the quantity of soda-lye requisite for precipitating the phosphoric acid as tricalcium phosphate. If we have dissolved 20 grms. superphosphate in 1000 c.c. of water and made up 200 c.c. to 250 by the addition of 50 c.c. of the calcium chloride solution, and if a is the measured quantity of soda-lye, b the solution of superphosphate and calcium chloride consumed, c the soda-lye used for neutralising the free acid, and t the standard of the soda-lye expressed as P_2O_5, the percentage of soluble phosphoric acid in the sample is—

$$= (a-c) \times t \times \frac{250 \times 1000 \times 100}{200 \times b\,20}$$

The method is applicable to ferruginous superphosphates.—*Zeitschrift fur Analytische Chemie* (vol. xxvi., p. 244).

DETECTION AND ESTIMATION OF SELENIUM IN METEORIC IRON.

By H. N. WARREN, Research Analyst.

The following is an outline of the analysis of several specimens of meteoric iron which have been lately brought before my notice, and which, during the course of analysis, were all more or less found to contain small quantities of selenium associated with the iron, the separation of which was effected as follows:—

By reducing 10 grms. of the specimen to a rough powder by filing and intimately mixing it with pure flour of sulphur in sufficiency, the whole being introduced into a stout piece of combustion tubing, and heated to redness. One end of the tube is in connection with an apparatus evolving oxygen gas, for the purpose of burning off the sulphur, forming sulphurous anhydride, and expelling with it the small quantity of selenious anhydride formed at the same time by the combustion of the selenium present; the further end is connected with a series of bulb tubes containing distilled water to collect the reduced selenium formed by the action of the sulphurous acid produced. The solution containing the precipitated selenium is next heated to a temperature of 80° F. to render it more dense, introduced into a platinum dish, dried in the air-bath and weighed (a blank estimation being in each case determined with the sulphur employed). The following is a tabulated view of the meteoric iron when separated from the matrix; *A*, *B*, from Bohumilitz; *C* Pallus iron; *D*, Elbogen; *E*, *F*, Atacama Desert.

A.

Iron	90·10
Nickel	6·54
Cobalt	0·24
Copper	—
Manganese	0·12
Selenium	0·23

B.

Iron	94·51
Nickel	2·54
Manganese	—
Cobalt	0·32
Copper	—
Selenium	0·050

C.

Iron	95·04
Nickel	3·20
Cobalt	0·12
Copper	0·20
Manganese	0·12
Selenium	0·04

D.

Iron	88·20
Nickel	8·20
Cobalt	0·12
Copper	—
Manganese	0·23
Selenium	0·06

E.

Iron	70·01
Nickel	20·02
Cobalt	—
Copper	—
Manganese	—
Selenium	0·08

F.

Iron	86·52
Nickel	10·52
Cobalt	0·12
Copper	—
Manganese	—
Selenium	0·05

ON THE

CONSTANCY IN THE HEAT PRODUCED BY THE REACTION OF ARGENTIC NITRATE ON SOLUTIONS OF METALLIC CHLORIDES.*

By THEODORE W. RICHARDS.

HAVING observed in some experiments made solely for practice that the heat produced by the precipitation of silver chloride from aqueous solutions of several metallic chlorides was directly proportional to the amount of silver nitrate used, the following investigation was made in order to determine whether this relation was really exact.

A standard solution of argentic nitrate was peparared by dissolving 100 grms. of $AgNO_3$ in one litre of water and diluting to 1250 c.c. 50 c.c. of this solution diluted to just 250 c.c. were used in each determination (except once when twice that amount was used), and the solutions of the various chlorides were made up so that 250 c.c. would contain a grm. or so more salt than was necessary to precipitate the quantity of silver nitrate used.

As the investigation was a question of comparison rather than of absolute measures, great care was taken to render the conditions as uniform as possible. For this purpose all the solutions and apparatus were left for twenty-four hours in a room of nearly constant temperature before being used.

The calorimeter was similar in every respect to that described by Berthelot, and the method of operation was exceedingly simple. In every case 250 c.c. of the solution of the metallic chloride were poured into the platinum calorimeter, and at the same time 250 c.c. of the silver solution (containing 4 grms. of $AgNO_3$ as stated above) were poured into a beaker, which had a capacity, when filled to the brim, of 255 c.c. The beaker was rested upon many folds of a non-conducting cloth, and surrounded by a cardboard cylinder with a movable cover.

When the temperatures of the liquids in both the calorimeter and the beaker (which were at first very nearly the same) had become constant after much stirring, they were noted, and the beaker was grasped by a heavily gloved hand and its contents poured rapidly into the calorimeter, the temperature of the resulting mixtures being noted.

Following is an example taken at random from the notebook.

Temperature of NH_4Cl sol. in calorimeter	17·220°
,, ,, $AgNO_3$ sol. in beaker	17·280°
Mean	17·250°
Final observed temperature	18·000°
Rise of temperature	0·750°

In every case the maximum temperature was attained in ten to fifteen seconds, so that no correction for cooling was necessary.

The water equivalent was always as follows:—

Solutions, 500 grms.; platinum calorimeter, 3·5 grms.; platinum stirrer, 1·5 grms.; thermometer, 5 grms. Total water equivalent = 505·5 grms.

Below is a table of all the results found.

The first column contains the number of the experiment, the second the chloride acted upon, the third the

* *Proceedings of the American Academy of Arts and Sciences.*

observed rise of temperature, and the fourth the amount of heat evolved in calors, and the last column the difference between the amount in each case and the average amount.

1. Sodic Chloride, NaCl .	0·760	16,220	+65
2. „ „ „ ..	0·750		
3. Potassic Chloride, KCl	0·750	16,110	−55
4. „ „ „ ..	0·750		
5. Ammonic Chloride, NH_4Cl	0·755	16,170	+5
6. Ammonic Chloride, NH_4Cl	0·750		
7. Barium Chloride, $BaCl_2$	0·750	16,110	−55
8. Cupric Chloride, $CuCl_2$	0·757	16,270	+115
9. Zinc Chloride, $ZnCl_2$..	0·760	16,320	+165
10. Manganese Chloride, $MnCl_2$	0·745	16,010	−155
11. Nickel Chloride, $NiCl_2$	0·755	16,110	−55
12. „ „ „	0·745		
13. Ferrous Chloride, $FeCl_2$	0·745	16,010	−155
14. Aluminic Chloride, Al_2Cl_6.	0·745	16,010	−155
15. Ferric Chloride, Fe_2Cl_6	1·520*	16·320	+165
16. „ „ „	0·760		
17. Chromic Chloride, Cr_2Cl_6.	0·760	16,320	+155
18. Hydrochloric Acid, HCl	0·760		
19. „ „ „	0·740	16,170	+5
20. „ „ „	0·755		
Average	0·7526	16,165	

It will be seen that all of these results are identical within the limit of error of the process. We may, therefore, draw the conclusion that the amount of heat evolved by the reaction thus represented—

$$(\tfrac{1}{n}R_m Cl_n + AgNO_3 + Aq) = AgCl + (\tfrac{1}{n}R_m (NO_3)_n = Aq),$$

is constant, no matter what R, m, or n may be.

Hence, also, *the difference between the heats of formation of equivalent amounts of nitrate and chlorides in aqueous solution is the same for any metal or basic radical.*

METHODS FOR DETERMINING PHOSPHORIC ACID AND MOISTURE.†

(1) *Preparation of Sample.*—The sample should be well intermixed and properly prepared, so that separate portions shall accurately represent the substance under examination, without loss or gain of moisture.

(2) *Determination of Moisture.* — (*a*) In potash salts, nitrate of soda, and sulphate of ammonia heat 1 to 5 grms. at 130° C. till the weight is constant, and reckon water from the loss. (*b*) In all other fertilisers heat 2 grms., or, if the sample is too coarse to secure uniform lots of 2 grms. each, 5 grms., for five hours at 100° in a steam-bath.

(3) *Water-soluble Phosphoric Acid.*—Bring 2 grms. on a filter, add a little water, let it run out before adding more water, and repeat this treatment cautiously until no phosphate is likely to precipitate in the filter. If the washings show turbidity after passing the filter, clear up with acid. When the substance is nearly washed in this manner, it is transferred to a mortar and rubbed with a rubber-tipped pestle to a homogeneous paste (but not further pulverised), then returned to the filter and washed with water until the filtrate measures not less than 250 c.c. Mix the washings. Take an aliquot (usually corresponding to ⅛ or ½ grm. of the substance) and determine phosphoric acid, as under "Total Phosphoric Acid."

(4) *Citrate-insoluble Phosphoric Acid.*—Wash the residue of the treatment with water into a 200 c.c. flask with 100 c.c. of strictly neutral ammonium citrate solution of 1·09 density, prepared as hereafter directed. Cork the flask securely and place it in a water-bath, the water of which stands at 65° C. (The water-bath should be of such a size that the introduction of the cold flask or flasks shall not cause a reduction of the temperature of the bath of more than 2° C.) Raising the temperature as rapidly as practicable to 65° C., which is subsequently maintained, digest with frequent shakings for thirty minutes from the instant of insertion, filter the warm solution quickly (best with filter-pump), and wash with water of ordinary temperature. Transfer the filter and its contents to a capsule, ignite until the organic matter is destroyed, treat with 10 to 15 c.c. of concentrated hydrochloric or nitric acid, digest over a low flame until the phosphate is dissolved, dilute to 200 c.c., mix, pass through a dry filter, take an aliquot, and determine phosphoric acid as under "Total."

In case a determination of citrate-insoluble phosphoric acid is required in non-acidulated goods, it is to be made by treating 2 grms. of the phosphatic material, without previous washing with water, precisely in the way above described, except that in case the substance contains much animal matter (bone, fish, &c.) the residue insoluble in ammonium citrate is to be treated by one of the processes described below.

(5) *Total Phosphoric Acid.*—Weigh 2 grms., and treat by one of the following methods; (1) Evaporation with 5 c.c. magnesium nitrate, ignition, and solution in acid. (2) Solution in 30 c.c. concentrated nitric acid with a small quantity of hydrochloric acid. (3) Add 30 c.c. concentrated hydrochloric acid, heat, and add cautiously and in small quantities at a time about 0·5 grm. of finely pulverised potassium chlorate.

Boil gently until all phosphates are dissolved and all organic matter destroyed; dilute to 200 c.c., mix and pass through a dry filter; take 50 c.c. of filtrate, neutralise with ammonia (in case hydrochloric acid has been used as a solvent add about 15 grms. dry ammonium nitrate or its equivalent). To the hot solutions for every decigramme of P_2O_5 that is present, add 50 c.c. of molybdic solution. Digest at about 65° C. for one hour, filter, and wash with ammonium nitrate solution. (Test the filtrate by renewed digestion and addition of more molybdic solution.) Dissolve the precipitate on the filter with ammonia and hot water, and wash into a beaker to a bulk of not more than 100 c c. Nearly neutralise with hydrochloric acid, cool, and add magnesia mixture from a burette; add slowly (one drop per second), stirring vigorously. After fifteen minutes add 30 c.c. of ammonia solution of density 0·96. Let stand several hours (two hours are usually enough). Filter, wash with dilute ammonia, ignite intensely for ten minutes, and weigh.

(6) *Citrate-soluble Phosphoric Acid.*—The sum of the water-soluble and citric-insoluble subtracted from the total gives the citrate-soluble.

Preparation of Reagents.

(1) *To prepare Ammonium Citrate Solution.* — Mix 370 grms. of commercial citric acid with 1500 c.c. of water; nearly neutralise with crushed commercial carbonate of ammonia, heat to expel the carbonic acid, cool, add ammonia until exactly neutral (testing by saturated alcoholic solution of coralline), and bring to volume of 2 litres. Test the specific gravity, which should be 1·09 at 20° C. before using.

(2) *To prepare Molybdic Solution.*—Dissolve 100 grms. of molybdic acid in 400 grms. or 407 c.c. of ammonia of specific gravity 0·96, and pour the solution thus obtained into 1500 grms. or 1250 c.c. of nitric acid of specific gravity 1·20. Keep the mixture in a warm place for several days, or until a portion heated to 40° C. deposits no yellow

* In this experiment 8 grms. of $AgNO_3$ were used.

† Official Methods of Analysis of the Association of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

precipitate of ammonium phospho-molybdate. Decant the solution from any sediment, and preserve in glass-stoppered vessels.

(3) *To prepare Ammonium Nitrate Solution.*—Dissolve 200 grms. of commercial ammonium nitrate in water, and bring to a volume of 2 litres.

(4) *To prepare Magnesia Mixture.*—Dissolve 22 grms. of recently ignited calcined magnesia in dilute hydrochloric acid, avoiding excess of the latter. Add a little calcined magnesia in excess, and boil a few minutes to precipitate iron, alumina, and phosphoric acid; filter, add 280 grms. of ammonium chloride, 700 c.c. of ammonia of specific gravity 0·96, and water enough to make the volume of 2 litres. Instead of the solution of 22 grms. of calcined magnesia, 110 grms. of crystallised magnesium chloride ($MgCl_2,6H_2O$) may be used.

(5) *Dilute Ammonia for Washing.*—One volume ammonia, of specific gravity 0·96, mixed with 3 volumes of water, or usually 1 volume of concentrated ammonia with 6 volumes of water.

(6) *Nitrate of Magnesia.*—Dissolve 320 grms. of calcined magnesia in nitric acid, avoiding an excess of the latter; then add a little calcined magnesia in excess, boil; filter from excess of magnesia, ferric oxide, &c., and bring to volume of 2 litres.

LEAD SLAGS.

By MALVERN W. ILES.

(Continued from p. 7).

Chemical Properties.

General Composition.—Lead slags are chiefly silicates of iron and lime; aside from these bases, manganese not infrequently plays an important part, as seen by analyses Nos. 9, 36, 37, 49, and 50. Zinc, alumina, baryta, and magnesia also sometimes enter slags as important constitutents, but these bases when present to any considerable extent will occasion trouble and are to be avoided if possible.

In argentiferous lead smelting the slag will always contain some lead and silver; in many cases these elements only exist in minute traces. From the fuel the slags derive some potassium and sodium and also phosphorus, but the amount is, however, quite small. Sulphur will always be found; the amount usually varies from 0·5 to 2 per cent. When copper ores enter the smelting mixture, some of this metal will also enter the slag, particularly in re-working the cupriferous matte; Dr. Wedding reported 0·27 per cent Cu_2O in the Saint Andreasberg slag in one instance, and in another case 0·50 per cent. In an analysis of the Clausthal slag, made in 1870, Hampe reported NiO + CoO, Cu_2S, and SbS_3; the phosphorus was reported as PO_5. Certain lead slags of Spain were once used as a source of vanadium. At Leadville, at one time, no less than three different mines were yielding vanadium in noticeable quantities. I have known a large ore mixture or "bed" to be smelted which contained no inconsiderable amount of these vanadium ores, and have detected vanadium in ores from the following different Leadville mines: Morning Star, Evening Star, Waterloo, Etna, and especially in ore from the Park mine. The Little Ellen mine, at Red Cliff, Colorado, was also found to contain a green vanadium mineral (supposed to be descloizite). Owing to the above mentioned facts, I think that vanadium is no uncommon constituent of the Leadville slags.

Aside from the above-mentioned elements, which are chemically combined, I have noted certain abnormal slags containing as a mechanical mixture portions of quartz varying in size from a mere speck to large white, usually rounded, pebbles from 2 to 3 inches in diameter. These pebbles were worked out through the tapping hole with difficulty, and when broken showed a dull, white colour resembling that of unglazed porcelain. Then again I have noticed sesquioxide of iron, sometimes in pieces an inch large; also pieces of quicklime; this, however, has only been observed when the furnace was being "blown out." In one instance quite a large piece (a quarter of an inch in length) of sulphide of zinc was found which was highly crystallised; this occurred at the very bottom of a cone of slag after breaking off the matte cake.

Before passing from this subject, it may be well to mention that by closely observing the very top of a pot of slag there will very often be found in blistered cavities exceedingly delicate needles; sometimes these crystals will appear almost white, then again of a yellowish tint (this is supposed to be due to oxide of zinc), and again others of a distinctly bluish tint. These bluish crystals have been found to contain both sulphur and lead, and are perhaps a subsulphide. These delicate crystals I have most frequently seen when the production of matte was large, although one of my metallurgical friends informs me that he also has noticed these crystals when scarcely any matte was formed. Shot-like globules of metallic lead have been observed in certain highly siliceous slags. Whenever the production of iron matte is unusually large it is not an uncommon thing to find rounded globules of it in the slag; this is particularly the case on the very outer rim of the pot.

Modes of Decomposition.—The ordinary method of fusing slags with carbonate and nitrate of soda in a platinum crucible will sometimes give good results; but since the slag always contains more or less lead it will be readily seen that the analyst runs the risk of either injuring or completely spoiling the platinum crucible by the reduction of metallic lead. A very good method of proceeding when the samples are not taken according to the method to be subsequently described, is to powder the slag well in an agate mortar, then digest with strong hydrochloric acid, evaporate once to complete dryness upon the water-bath; then add more hydrochloric acid, filter, and fuse (or, better, agglomerate, or semi-fuse) the residue with sodium carbonate in a platinum crucible, and proceed as usual according to the well known method for the determination of insoluble silicates.

The above mode of precedure is found somewhat long for the practical uses in connection with industrial works, where time is a great desideratum. To facilitate the fusion and also to prevent the liability of destroying costly platinum crucibles, I have for a long time used a method of fusing the slag in a silver crucible with caustic potash and then proceeding as usual in the analysis. The method last described has the advantage that the heat required for the fusion is quite small, in fact an ordinary alcohol lamp is found sufficient; and as many laboratories connected with the lead smelting works have neither gas nor the improved gasoline burners, the method is therefore very serviceable. The disadvantage is that the silver crucible is always slightly attacked by the caustic alkali, and when a complete analysis is to be performed the silver gives trouble in some of the determinations. This difficulty is, however, entirely overcome if a platinum crucible is heavily plated with gold, as has been suggested by W. Bettel in the Chemical News.

A method which I will now describe has been used for several years in connection with these works, and leaves little to be desired. If in taking the laboratory sample we use an ordinary steel bar, throw aside the crust from a newly-drawn pot of slag, dip the reversed end of the bar about 2 inches into the molten slag, then quickly plunge into a bucket of water, and use this sample for analytical determinations, it will be found that all slags made in lead smelting will be entirely decomposed by strong hydrochloric acid, giving rise to perfectly pure gelatinous silica.

By using a small amount of acid, and with a little practice, one can determine the silica, iron, and lime contained a slag in less than two hours.

Quantitative Analysis.—After taking the slag sample, as previously indicated, weigh out from half a grm. to one

grm., transfer to a covered casserole, add from the wash bottle a few drops of water, stir well, and add concentrated hydrochloric acid; again stir, and digest over a free flame for a few minutes. The addition of water and the stirring prevent the slag from clotting or caking upon the bottom of the vessel. Now add a few drops of nitric acid, both to insure the oxidation of the iron and also to decompose the few particles of lead sulphide which are apt to form during the first addition of hydrochloric acid, and rise upon the sides of the vessel. Sometimes these black specks are due to carbon, which will, of course, be burned off in the ignition of the silica. Evaporate to dryness upon the water-bath; this is not a long operation if the analyst uses a minimum quantity of acid (say, 6 to 8 c.c.). After the evaporation is completed add a few drops of water, just sufficient to moisten the mass, and evaporate a second time. Now add a slight excess of concentrated hydrochloric acid; warm, dilute, and filter, washing the silica with boiling water, and drop a small amount of hydrochloric acid around the edges of the paper; wash again with water. The moist residue, with the paper, is transferred directly to either a porcelain or a platinum crucible, placed in an ordinary scorification cup, and dried before the assay muffle until the paper begins to carbonise. It is then placed in the muffle for about five minutes, removed and allowed to cool, and the silica is then weighed. The silica will be found perfectly white, not even tinted with iron, and the determination is as accurate as if a fusion had been performed.

For the determination of the iron it is advisable to take a second portion of half a grm., boil with hydrochloric acid to complete decomposition in a casserole, then dilute with water and add a small piece of unamalgamated zinc directly into the covered vessel. After a few minutes the cover is removed, washed, and the contents of the casserole are cautiously transferred by decantation to a large beaker, and diluted with water up to 500 c.c.; now add rather a large amount of concentrated sulphuric acid (say 25 c.c.) and titrate the iron with a standard solution of potassium permanganate.

It will be noted that it is entirely unnecessary to remove the silica in order to determine the iron, and furthermore time is saved by reducing the iron by unamalgamated zinc directly in the vessel in which the decomposition of the slag is effected. For commercial work a solution of permanganate is made by dissolving 5·686 grms. of the salt in one litre of water.

For the estimation of lime two methods are used, according to the degree of accuracy to be attained. If, for quick work, we wish to ascertain the percentage of lime we use the filtrate from the silica as follows:—Heat this filtrate, add ammonia to a slight alkaline reaction, then add a saturated solution of oxalic acid to dissolve the iron; boil for a few minutes, allow to stand twenty-five minutes, filter hot, wash well, and transfer to a casserole; add some hot water and sufficient hydrochloric acid to dissolve the calcium oxalate, filter, and dilute with cold water. Now add rather a large amount of sulphuric acid, heat to boiling, and titrate with the same solution of permanganate as was used in the iron determination. If a greater degree of accuracy is desired the iron and alumina are removed as basic acetates, then the manganese is separated by bromine water, the zinc removed by sulphuretted hydrogen, and the filtrate treated according to the usual methods for estimating the lime.

Some manganese will invariably pass into the filtrate when the iron is precipitated by ammonia, and will come down with the lime, thus introducing an error to the extent of its presence. When, however, the amount of manganese is small in comparison to the amount of iron, we can often use the first-mentioned method with a great saving of time.

For the determination of the manganese, from 1 to 2 grms. of the finely divided slag is used, according to the amount present: this is treated in a casserole with concentrated hydrochloric acid, with the addition of a small amount of nitric acid in order to convert all the iron into the ferric form. Now boil, and add sulphuric acid, gradually replacing all of the nitric acid, and also hydrochloric acid: the success of the operation depends upon the entire removal of the hydrochloric acid. Dilute to about 150 c.c. and boil; add an emulsion of zinc oxide in large excess, by which the iron is precipitated as ferric hydrate; filter off the silica and oxides of zinc and iron, and dilute to 500 c.c. Some writers recommend, before the addition of zinc oxide, neutralising with sodium carbonate, and then clearing the solution with a few drops of nitric acid; this in practice is found to be unnecessary. Draw off from the diluted liquid, after thorough mixing, an aliquot part (say 100 c.c.), transfer to a casserole, heat to boiling, and titrate with frequent stirring with the same permanganate as was used for the iron and lime until the first rose tint is observed. Calculate the percentage of iron corresponding to the permanganate used, and multiply this percentage by 0·2946 (=per cent Mn). The manganese scheme as above stated is highly recommended, both for its rapidity and accuracy; in fact there is no known method which I think will compare with it for technical and scientific work.

The sulphur is determined by the "Fahlberg-Iles" method as follows:—Fuse 1 to 2 grms. of finely divided slag in a silver crucible (or gold-lined platinum crucible) with 25 grms. potassic hydrate for twenty minutes; cool, dissolve in water, filter off the hydrated oxides of iron, &c.; now add 30 c.c. bromine water, and then concentrated hydrochloric acid to an acid reaction; boil off excess of bromine, filter if necessary, add barium chloride, and proceed as usual for the treatment of barium sulphate.

If other constituents are to be determined the methods are followed as given by Fresenius, Rose, Sutton, Cairns, or Hart.

(To be continued).

VALUATION OF INDIGOES.

An Investigation into the Various Methods Employed for the Estimation of Indigotin, together with certain New and Modified Processes.*

By CHRISTOPHER RAWSON, F.C.S.

(Continued from p. 8).

Action of Potassium Permanganate upon Indigo-Gluten, Indigo-Brown, and Indigo-Red.—I have made a few experiments in order to discover, if possible, how the various constituents of indigo are affected by potassium permanganate. Twenty grms. of a medium quality of indigo were successively treated with hydrochloric acid, sodium hydrate, and alcohol. These extracts were separately evaporated to dryness, and a weighed portion of each treated with concentrated sulphuric acid, and afterwards diluted with water and filtered. The filtered solution in each case was mixed with 50 c.c. of a standard solution of pure indigo-sulphate, and titrated with potassium permanganate. The "alcoholic extract," consisting principally of indigo-red, dissolved in sulphuric acid with a dark crimson colour, but, on the addition of water, a brown precipitate formed, showing that some indigo-brown was also present in the extract.† An exact quantitative result cannot be given, but, judging from the amount of permanganate decolourised, it appears that indigo-red acts upon potassium permanganate in a similar manner to indigotin. The "sodium hydrate extract," consisting of indigo-brown, dissolved in sulphuric acid with a deep dark brown colour, but, on the addition of water, it was almost entirely precipitated. The filtered solution had very little action upon potassium permanganate. The "hydrochloric acid

* *Journal of the Society of Dyers and Colourists*, No. 4, Vol. I.

† This experiment would have been repeated, but time did not permit.

extract" contains indigo-gluten resinous substances, mineral matter, &c. The solution decolourised a considerable amount of permanganate, which was found to vary in quantity, according to the quality of the indigo from which the extract had been prepared. Much of this decolourising action was found to be due to the presence of iron in the ferrous state. Indigo-red can scarcely be considered an impurity of indigo, and as indigo-brown does not sensibly affect the results it is evident that the inaccuracy of the permanganate method is due to the presence of substances soluble in hydrochloric acid.

In order to eliminate this error I have made use of the property of sodium sulphindigotate, being insoluble (or nearly so) in a strong solution of common salt. As the precipitate does not immediately separate from solution, the modified process takes a somewhat longer time to perform, but the amount of extra labour is very little, and what is most important, very good results are obtained. The 50 c.c. of the filtered solution of indigo, instead of being directly titrated with permanganate, are mixed in a small flask with 50 c.c. of water, and 32 grms. of common salt. The liquid, which is thus almost saturated with salt, is allowed to stand for two hours,* when it is filtered and the precipitate washed with about 50 c.c. of a solution of salt (sp. gr. 1·2). The precipitated sulphindigotate of soda is dissolved in hot water, the solution is cooled, mixed with 1 c.c. sulphuric acid, and diluted to 300 c.c. The liquid is then titrated with potassium permanganate as before. It is necessary to make a slight correction in order to allow for the small quantity of sodium sulphindigotate which dissolves in a saturated solution of common salt. This correction I have found in my own experiments to be 0·0008. On reference to Table No. II. it will be seen that results obtained by this modified process agree on the whole very closely with the combined percentages of indigotin and indigo-red.

Calculation of results :—

Example I.—By direct titration—

(One c.c. potassium permanganate = 0·0015 indigotin). 1 grm. of "Kurpah" indigo was dissolved in sulphuric acid, diluted to a litre, and filtered ; 50 c.c. (= 0·05 indigo) diluted with 250 c.c. of water required 14·5 c.c. of permanganate ;

$$\therefore \frac{0{\cdot}0015 \times 14{\cdot}5 \times 100}{0{\cdot}05} = 43{\cdot}50 \text{ per cent indigotin.}$$

Example II.—After precipitation by sodium chloride—

Fifty c.c. (= 0·05 indigo) of the above solution were mixed with 50 c.c. of water and 32 grms. of common salt. The precipitate was collected on a filter and dissolved in 300 c.c. of water containing 1 c.c. of sulphuric acid. This solution required 12·7 c.c. of permanganate ;

$$\therefore \frac{(0{\cdot}0015 \times 12{\cdot}7 + 0{\cdot}0008) \times 100}{0{\cdot}05} = 39{\cdot}70 \text{ p. c. indigotin.}$$

Potassium Ferricyanide Process.—This method, which was recommended by Ullgren, may be found fully described in the *Journal of the Chemical Society*, 1865, p. 223. It is based upon the fact that potassium ferricyanide (red prussiate of potash), in the presence of free alkali, changes indigo blue into isatin. Ullgren says that the quantity of sulphuric acid employed for dissolving the indigo must not be more than ten times the weight of the indigo taken, and that the mixture should not be exposed to a temperature exceeding 50°. When 1 grm. of indigo has been dissolved and diluted to 1 litre, 10 c.c. are taken and mixed with 20 c.c. of a cold saturated solution of sodium carbonate, and 1 litre of distilled water in a porcelain basin ; a weak solution of potassium ferricyanide (2·5115 to litre) is gradually added during constant stirring with a glass rod. The impurities present in commercial indigoes do not so much interfere with this reaction as in the methods previously mentioned, still the results obtained are too high, and, furthermore, as both the solution of indigo and that of the ferricyanide must necessarily be very dilute, the end of the reaction is not sharp, and consequently analyses made with the same sample of indigo do not agree so well as those obtained by the permanganate method.

(To be continued.)

* If the liquid be strongly agitated by drawing a current of air through the solution, the precipitate completely separates in less than half an hour.

NOTICES OF BOOKS.

A Course of Quantitative Analysis for Students. By W. N. Hartley, F.R.S. London and New York: Macmillan and Co.

The author takes for his motto the saying of Fresenius, that "One may be a good analyst without having tried *every* method or determined *every* body." In the spirit of this very true dictum he gives us not a complete series of methods for the determination of every known body, but a judicious selection of procedures calculated to instruct the student in most matters with which the analyst should be familiar. In his Preface he remarks that "to be a good analyst does not necessitate a profound knowledge of chemistry, nor does the possession of extensive knowledge and a brilliant intellect enable one to dispense with practice in the execution of analytical operations." He might have added that here, as in many other spheres of activity, knowledge—however profound—is insufficient without a certain tact impossible to be described.

The work opens with a table of metrical weights and measures and their English equivalents, concerning which we have merely to remark that a comparison between the cubic inch or the fluid ounce and the cubic centimetre is less useful than would be one between the latter and the grain-measure.

The Introduction, which follows next, consists of very judicious directions concerning manipulation. Though the space devoted to this subject is necessarily limited, we are much pleased with the nicety evinced. The student is forewarned against possible sources of error which we have seen overlooked in bulkier works.

After this section we come to a series of introductory examples, intended mainly to convey the meaning of atomic weights and equivalent weights.

A table is given for some of the more important elements of the atomic weights as commonly used, as revised, as calculated by F. W. Clarke, on the basis O = 15·963, and those by Van der Plaats, O = 16. The author considers that for commercial purposes it is almost as necessary to use the ordinary atomic weights as it is to buy and sell by the legalised weights and measures. To employ the old atomic weight for platinum, Pt = 197, must, however, involve a grave error.

We next find estimations of mineral constituents, *e. g.*, of moisture, sodium, chlorine, sulphuric acid, copper, carbonic acid, lime, magnesia, &c. The methods prescribed are satisfactory, and they are most clearly and carefully described.

In the section on volumetric analysis we note that the author uses nitric acid in alkalimetry. The determinations here given for water are those of chlorine and of hardness.

Under "Technical Analysis" we find instructions for the quantitative examination of coal, pyrites, burnt ore, and superphosphate. As regards this last substance there is no mention of the determination of "reverted" phosphoric acid.

The last main section of the work treats on the analysis of alloys and complex minerals.

As an Appendix follow hydrometer tables. Organic analysis does not come within the author's plan, though he has given volumetric processes for the determination of sugar and of urine.

The only defect of moment which we perceive in this book is the absence both of a table of contents and of an index. The work will be of great use not merely to the student who is seeking to master the principles and practice of analysis, but occasionally even to the matured and experienced chemist.

A Text-Book of Paper-making. By C. F. Cross and E. J. Bevan. London and New York: E. and F. N. Spon.

Messrs. C. F. Cross and E. J. Bevan are generally and favourably known to chemists from their important researches on cellulose, and we therefore welcome their work on the paper trade. There is, perhaps, no other industry of equal importance which has so scanty a literature. This deficiency is by no means peculiar to England, if we may judge from the bibliography appended to the volume before us, in which are enumerated only sixteen complete works and three journals. Whether this paucity is due to the scarcity of scientific research, or to an indisposition on the part of practical men to discuss trade questions, it might be unsafe to pronounce.

The authors begin their task with an examination of the chemistry and the natural history of the cellulose group. They note the general inertness of cellulose and the paucity of its reactions. The nitro-compounds are described from the hexa-nitrate—formerly known as trinitro-cellulose—down to the dinitrate, a body hitherto but little studied. We have also an account of the oxygen compound, the α-oxycellulose of Witz, characterised by its well-marked affinity for the basic colouring-matters, which dye it full shades, and by its remarkable attraction for the vanadium compounds.

Under the decomposition products of cellulose they mention amyloid, commonly known—in some forms at least—as parchment-paper, and its near ally hydrocellulose, as also β-oxycellulose, first described by the authors. We cannot help suggesting that a more complete study of cellulose and its products from a tinctorial point of view might prove of importance to the dyer and printer. The action of alkalies upon cellulose is here described, but there is no reference to mercerisation.

It is mentioned that the soluble ferment of the foxglove converts cellulose into glucose and dextrine, and that the fluid from the vermiform appendage of the cœcum of the rabbit digests cellulose, with formation of a saccharine product and the liberation of marsh-gas. On the other hand, the so-called "vinegar plant" is capable of transforming levulose into cellulose. The synthesis of cellulose, which is effected spontaneously in beet-juice, has not been generally investigated.

In certain plants there occurs a formation of compound celluloses, a class of bodies of which jute may serve as the type. The authors consider that the chemistry of jute throws a light on the process of lignification.

The reactions of jute, or we may say of ligno-cellulose in general, differ distinctly from those of unmodified cellulose. On its reaction with iodine the authors found their method for the determination of (mechanical) wood-pulp in paper. But if anyone wishes to learn how far-reaching is the chemistry of cellulose, and what closed doors—theoretical as well as technical—it may yet unfasten, we must recommend him a careful study of the remaining portion of this chapter.

The authors then enter upon the study of the physical structure of fibres, as a necessary preliminary to their microscopic and micro-chemical examination and diagnosis. Here we find a classification of the plant fibres which come under the hands of the paper-maker and the dyer. There are first the cottons, which are seed-hairs, the purest form of cellulose occurring in Nature; then the bast-fibres, partially lignified cellulose, such as flax, hemp, China grass, ramie, jute, paper mulberry, and linden-bast. Lastly come the fibro-vascular bundles met with in New Zealand flax and esparto.

A following chapter gives a formal scheme for the analysis, qualitative and quantitative, of plant substances. Next follows an account of the chemical and physical features of the more important raw materials, with illustrations showing their appearance under the microscope. This chapter will be of especial value to the student who wishes to familiarise himself with the structure of the various fibres. The chemical reactions and the percentage compositions of the raw fibres are duly given. Jute is mentioned as containing 24 per cent of lignine to 63 of true cellulose, whilst cotton contains no lignine and 91 of cellulose.

The authors then pass to the general processes by which the paper-maker isolates celluloses in available forms from the raw materials above described. These processes resolve themselves into two main groups, the alkaline and the acid treatment, the agents employed in the former being soda, caustic or carbonated, and lime, whilst in the latter processes sulphurous acid plays a principal part. This process is very carefully described, though we find no reference to the claims of the younger Mitscherlich, and to his contention that the prior invention of Tilghman should not be held to anticipate his patent.

The discussion of the special treatment of various fibres introduces the distinction between the two kinds of wood-pulp, the chemical and the mechanical, so called from the nature of the processes by which the wood is reduced to fibres. The authors observe that mechanical wood-pulp has little felting power, and that paper containing it readily becomes discoloured by the action of air and light.

In the chapter on bleaching we find a favourable notice of the electrolytic process of M. Hermite, which the authors consider economically advantageous. They state that "if a solution be taken of equal oxidising efficacy with one of calcium hypochlorite it is found that the former possesses greater bleaching efficiency in the proportion of 5 to 3." The bleaching is also more rapid, and the loss of weight, for equal degrees of whiteness, is smaller. As the process is now in industrial action, this estimate will soon be either practically verified or refuted.

The remaining chapters of the work, into which we have not space to enter, are devoted to the consideration of beating, loading, sizing, and colouring, the recovery of caustic soda, testing papers chemically and mechanically, general chemical analysis for paper-makers, and the Willesden paper process.

Messrs. Cross and Bevan may be congratulated on having produced *the* book on the paper-industry.

Colour: an Elementary Manual for Students. By A. H. Church, M.A., F.C.S., F.I.C., Professor of Chemistry in the Royal Academy of Arts, London. New and enlarged Edition. London, Paris, New York, and Melbourne: Cassell and Co.

The former edition of this Manual appeared as far back as 1871, and has been long out of print. Hence the present issue, which is much enlarged, may fairly be regarded as a new work. Prof. Church addresses himself mainly and as by right to artists; but in our opinion his treatise will prove of very great value to chemists and biologists, who constantly require to perceive colours accurately and to describe them faithfully. It may also be recommended to dyers, tissue printers, and fancy manufacturers. Many a time has our soul been troubled by seeing colours in textile goods, in themselves pure and beautiful, so arranged that instead of enhancing they deteriorated each other.

The first chapters of the work are devoted to a general explanation of the general principles of optics, necessary for an understanding of what has to follow. At the very outset he reminds his readers that "colour is, in fact, an internal sensation, and has no external and objective existence." This simple truth is very often overlooked,

even by persons whose pursuits require the constant scrutiny of colour.

We are by no means sorry to find a criticism of the relationships often assumed between sound and light. Prof. Church points out that whilst sound-waves move in the direction of their path, light-waves move transversely; that there is no definite ratio between the typical colour intervals and the musical intervals of the octave; that the eye appreciates differences in wave-lengths in the middle region of the spectrum better than at either end, whilst the ear does not evince a similar peculiarity with relation to musical sounds. Again, we *see* but one octave of colours, though we hear eleven octaves of sounds. Whether there is any meaning in the fact that we have an octave alike in sound, in colour, and in the natural arrangement of the chemical elements,—Mr. Newlands originally proposed for the "periodic law" the name Law of Octaves,—or whether we have here a casual coincidence, it would be premature to decide.

The "symbolism of colour," the author holds, "scarcely admits of serious consideration." In many respects this is doubtless true. Still there is one consideration not unworthy the attention both of artists and *savants*. It is this: in the organic world beings normally display purer and brighter colours as they approach their summit of development, whilst decline, disease, and death are heralded by impure colouration.

Chapter V. contains the definition of some terms often used in a very loose manner. The *hue* of any colour is its difference, as red or orange, green or blue, &c. *Purity* is the absence, more or less complete, of any admixture of white, and brightness is the total amount of light reflected to the eye. Under this head we find mention of Capt. Abney's curious observation that at great elevations the region of maximum luminosity in the spectrum is shifted from its ordinary position about D towards the more refrangible end.

By *tints* Prof. Church understands the normal hue mixed with progressively increasing quantities of white. By *shades* he means the normal hue mixed with progressive increments of black. It is to be regretted that these terms are not used in the same sense by all who have to work with colours. What are here called *hues* are named by dyers and colour manufacturers *tones*, who apply the term *shades* to the different grades of concentration of one and the same hue in the utter absence of any admixture of black.

The author regrets the confusion existing between violet and purple, which are often taken as synonymous. He evidently hopes that some day an "International Colour Standard Conference" of artists and scientists may fix upon a nomenclature, to be preserved by means of hues reproduced in enamel.

To give an analysis of the latter portion of the work, where the mutual relations of colours are considered, would be impracticable within our limits. Some of the practical applications of general principles may be briefly touched upon.

The author remarks on the difficulty, and sometimes the impossibility, of properly associating marbles and similar natural materials with tiles. In marble there is some approach to translucency with which the dull, dry, opaque surface of pottery contrasts unpleasantly. Again, in a carved capital of variegated material, "Nature's designs in colour are disfigured by man's work in light and shade, and the sculpture itself is ruined by the casual way in which the projecting portions are here and there darkened by a rich mottling, whilst the recesses are brought into prominence by reason of the paleness of that part of the marble in which they are wrought."

Whoever reads this book carefully will, we think, agree with us that if the principles here clearly expounded were followed out in our art manufactures, we should indeed welcome a *renaissance*.

Modern American Methods of Copper Smelting. By E. D. Peters, Jun., M.D., M.E. New York: Scientific Publishing Company.

The author of this useful work arranges the copper districts of North America in four groups, viz., the beds of the Atlantic Coast, the deposits of Lake Superior, the system of the Rocky Mountains and the Sierra Nevada, and, finally, the deposits of Arizona and New Mexico. The Lake Superior deposits are remarkable for the abundant occurrence of native copper. Their value depends not so much on a high percentage of metal as on its occurring in a state which renders unnecessary the costly series of calcinations and fusions necessary in sulphuretted copper-ores, and on the absence of arsenic and other impurities. In New Mexico and Texas the metal occurs in the shape of fossilised shells, fishes, leaves, and twigs, all transmuted into impure copper glance. Malachite does not occur in the United States of sufficient purity to be fit for ornamental purposes.

The chapter on copper assaying opens with an account of the sampling process. The Cornish method is laid aside in favour of certain automatic machines, of which that of Brunton, of Denver, which is here figured and described, receives the preference.

Four methods of copper assay are here described,—the Parkes titration process, precipitation with zinc or iron, the colorimetric process, and the electrolytic assay. The Parkes method he considers sufficiently accurate in the absence of zinc, antimony, and arsenic. The colorimetric method he reserves, as do English metallurgical chemists, for slags and tailings. The battery assay he finds suited to every class of ore and every percentage of copper, and as combining ease of execution and extreme accuracy. The Cornish assay he justly condemns, on account of its difficulty and inaccuracy. At the same time he considers that there is little immediate hope of its being abolished, on account of its being interwoven with the commercial customs of the Swansea smelters. He describes, however, at some length, a fire assay practised at Lake Superior, and apparently well adapted to the class of ores there to be dealt with.

He adds the interesting practical note that, in an establishment handling 35 tons per day, the cost of sampling per ton was 37 cents, and that of assaying 18¼ cents.

Coming to actual work we notice that the author does not touch upon the wet methods for the extraction of copper. To have done so would have increased the size and cost of the book to an undesirable extent. A praiseworthy feature is that he goes into the question of cost, both of construction and of subsequent working, "not calculating expenses as they appear on paper, and when everything is running smoothly, but giving the actual results of building on a large scale and of smelting many thousand tons of ores under varying circumstances and in all of the ordinary kinds of furnaces."

In successive chapters he discusses the roasting of copper ores in lump form, the term roasting being in America understood differently from in England, and signifying the exposure of ores containing sulphur, arsenic, and other non-metals to a comparatively moderate temperature for the purpose of effecting certain required chemical changes. This definition, he tells us, "is restricted to the dry metallurgy of copper. He then proceeds to stall-roasting, and to the roasting of ores in lump form in kilns. This latter operation is chiefly carried on with a view as much to the manufacture of sulphuric acid as to the calcination of ore. He states that if an ore contains 8 per cent of copper it cannot be profitably burnt for sulphuric acid. The Canadian cupreous pyrites used in the vitriol works of Boston and New York contains only 45 per cent of sulphur, on account of a greater percentage of gangue than is found in Spanish ores.

It appears that in Massachusetts a company erected plant for obtaining sulphuric acid and copper from iron monosulphide, which cannot contain more than 36 per cent of sulphur, and which behaves badly in the kilns.

The author considers that an ore containing as little as 25 per cent of sulphur may be burnt, if it has no otherwise objectionable properties. We never heard of an ore or mixture so low as this being used in any works in England.

After discussing the calcination of ore and matte in a finely divided condition, Dr. Peters passes on to the "Chemistry of the Calcining Process." Here the successive changes occurring at different stages of the process are clearly described.

The smelting of copper and the comparative advantages of blast furnaces and reverberatories are next discussed. For smelting ores the cupola is advantageous with highly ferruginous ores, where the cost of anthracite or coke is not much greater than that of bituminous coal, &c., for oxidised ores, for low-grade native copper, and where clean slags are a necessity. On the other hand, the author prefers the reverberatory for refractory siliceous, aluminous, calcareous, or magnesian ores, where the composition of the ore changes suddenly, where bituminous coal is very much cheaper than anthracite or coke, and for smelting and immediately refining rich native copper.

The chapter on the treatment of auriferous and argentiferous copper ores is very brief. The Ziervogel process is set aside as requiring very pure materials and exceptional skill, and as not providing for the extraction of gold. The electrolytic methods are still largely in the experimental stage. But the Hunt and Douglas method seems to suit the demands of the case better than any previous device.

The author has had practical experience in the Bessemerising of copper mattes. He finds that the elimination of antimony and arsenic was highly satisfactory, and believes that this process has a great future before it.

The work is furnished throughout with illustrations of plant drawn to scale, and under every operation we find statements of the expense given from actual practice.

The utility of the book is beyond all question, and we feel confident that it will be welcomed by metallurgists on both sides of the Atlantic.

CORRESPONDENCE.

WARNING TO CHEMISTS.

To the Editor of the Chemical News.

Sir,—I shall be obliged if you will call the attention of chemists to an impostor who is travelling from place to place and obtaining money under false pretences from unsuspecting chemists.

He speaks German fluently, and is evidently a German by birth, but his pronunciation is indistinct. He claims to be a chemist and a Ph.D., and states that he is out of employment and hard up.

He is of average height, and inclined to be slender; his complexion is fair, and he has a short moustache, but no beard. His eyes are deep set and half closed, and he claimed to have lost his spectacles when he called upon me. He wore then dark grey striped trousers, a long light brown jacket, and a shabby black felt hat.

From information I have obtained he appears constantly to produce a pawn-ticket, which he offers to sell. He showed me two, one of a gold watch and albert pledged n Glasgow, and the other for an overcoat pledged in this locality, to obtain money for his previous night's lodging.

He seems to have travelled a good deal in the neighbourhood of Glasgow and Edinburgh, and imparts a vast amount of information regarding chemists, chiefly Scotch, for the most part *false*.—I am, &c.,

Ph.D., F.I.C.

The Pure Culture of Yeast.—Dr. Hansen.—The author insists on the culture and use of a pure ferment.—*Moniteur Scientifique.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cv., No. 24, December 12, 1887.

On the Various Modes of the Explosive Decomposition of Picric Acid and of Nitro-compounds.—M. Berthelot.—The author describes the variety of the modes of decomposition of the nitro-compounds, properly so-called, and how they depend on the initial temperature of the decomposition. In cases where the surrounding medium presents a mass large enough to absorb the heat as it is produced, there ensues neither deflagration nor detonation. However, if a nitro-compound, such as picric acid, when burning in the air in a large mass, heats the side of the vessel to such a degree that deflagration commences, this may contribute to raise still further the temperature of the recipient, and the phenomenon is sometimes ultimately converted in detonation. If this takes place at one isolated point, as in a fire, or by the local overheating of a boiler or other apparatus, an explosive wave is generated, and is propagated by influence through the entire mass, producing a general explosion.

Compressibility of the Watery Solution of Ethylamine.—F. Isambert.—(See p. 13).

Fermentable Glyceric Aldehyd.—E. Grimaux.—It results from the author's researches that oxidised glycerin yields a glyceric aldehyd which possesses the property of undergoing the alcoholic fermentation. This is the first time that a fermentable sugar, presenting the same reactions as glucose, has been obtained synthetically. The definition of the fermentable sugars must be modified now they are not necessarily carbohydrates containing C_6 or C_2.

Action of Sulphuric Acid and Oil of Turpentine.—G. Bouchardat and J. Lafont.—The product of this reaction is not terebene or inactive camphene, as this compound is formed by the decomposition of a sulphuric compound, not yet described.

Attempt at the Diagnosis of the Volatile Alkaloids.—Oechsner de Coninck.—The author proposes to combine a known weight of the alkaloid with the calculated quantity of methyl or ethyl iodide. The solid compound formed is then dissolved in a slight excess of absolute alcohol, the solution is heated slightly and mixed, drop by drop, with a lye of potassa at 45°. Different portions of the iodoethylate or iodomethylate are then variously treated, being, amongst other reactions, converted into chloroplatinate and chloraurate.

Detection of Aldehyds in the Alcohols of Commerce.—U. Gayon.—(See p. 13).

Moniteur Scientifique, Quesneville. Series 4, Vol. i., September, 1887.

Manufacture and Adulteration of Beer.—F. Schwackhofer.—The author gives a formidable list of adulterants, ranging from pure water, gaseous water, extract of liquorice, and glycerin, to worm-wood, gentian aloes, picric acid, strychnine, brucine, quinine, and colchicum. The use of these latter substances he regards as doubtful. The caramel employed as a colouring-matter is generally obtained, not from cane-sugar, but from glucose. The use of such caramel should, in the author's opinion, be prohibited.

Bacteria in Breweries.—H. Fischer.—The author who speaks of bacteria alternately as plants and as animals, enumerates the following species as occurring in breweries; *Bacterium lacticum*, *B. aceti*, *B. pastorianum*,

Clostridium butyricum, *Micrococcus ureæ*, *Crenothrix Kuhniana*, and *Beggiatoa alba*. The last mentioned of these organisms is nothing other than sewage fungus.

New or Improved Methods of Determining Organic Substances by Means of Potassium Permanganate.—J. H. Smith.—From the *Journal Society Chemical Industry*.

Use of Nitroso-β-Naphthol for the Separation of Different Metals.—G. von Knorre.—The author, in conjunction with M. Ilinski, described a method for separating cobalt from nickel and iron from aluminium, founded upon the use of nitroso-β-naphthol. E. Breutel has verified the accuracy of the method, and recommends it warmly. Since then the author has extended his researches. Nitroso-naphthol precipitates the acetic solutions of cobalt, iron, and copper, whilst aluminium, lead, cadmium, calcium, magnesium, manganese, nickel, mercury, and zinc remain in solution. To separate the first three metals from the others he proceeds as follows:—The solution containing the metals as sulphates or chlorides and reduced, if needful, to a small volume, is treated with ammonia in slight excess and then re-acidified by adding hydrochloric acid, drop by drop, until the precipitate formed by the ammonia has disappeared. The liquid is then heated to 90° to 95°, and an excess of nitroso-β-naphthol dissolved in acetic acid at 50 per cent is then added at the same temperature. It is convenient to pass the hot solution of nitroso-naphthol through a small dry filter and let it drop directly into the liquid to be precipitated. If cobalt alone has to be precipitated there is no occasion to attend to the acidity of the liquid, which does not in the least interfere with the precipitation. If the solution contains much alumina it is better to precipitate in the cold to avoid the separation of basic aluminium acetate. For this purpose we add to the solution half its volume of acetic acid at 50 per cent, and then an excess of the nitroso-naphthol reagent. For small quantities of alumina we may operate in heat, taking the precaution to acidulate with acetic acid, as already said. To ascertain that an excess of nitroso-naphthol has been added we receive a drop of the precipitate in a watch-glass and add a drop of a solution of cobalt. The formation of cobalti-nitroso-naphthol (purple) at once indicates the excess of the reagent. At least 1 grm. of nitroso-naphthol is required to precipitate 0·1 grm. of iron. After standing for some hours in the cold the precipitate is collected and washed with cold water until a drop of the filtrate no longer leaves a residue upon platinum foil. The dried precipitate with the filter is introduced into a roomy porcelain crucible, previously tared, which is covered loosely and heated at first very moderately, either on the sand-bath or on a sheet of iron, until vapours no longer escape. The heat is then gradually raised, and we finish with a strong ignition until all the organic matter is burnt off. The iron is then weighed as Fe_2O_3. Cobalt, after ignition, is heated to redness in the usual manner in a current of dry hydrogen. For separating and determining mixtures of iron and alumina or chromium we make up the liquor to a known volume, and in an aliquot part of it we determine the iron as above. In another aliquot portion we determine the mixed oxides by precipitating with ammonia in the usual manner. The weight of the alumina or chrome is then found by deducting the iron from the mixed oxides.—(*Chemische Industrie*).

Aniline Colours Soluble in Benzene.—A. Müller-Jacobs.—The precipitates formed by metallic salts (alum, zinc sulphate, &c.) in the solutions of resin soaps carry down with them any colouring-matters which exist dissolved in the liquid at the same time as the soap. This is particularly applicable to basic coal-tar colours, forming coloured metallic soaps, aluminium, or zinc resinates, which dissolve along with their colour in neutral solvents such as benzene, chloroform, ether, and carbon disulphide, and may serve for colouring oil-varnishes, solutions of caoutchouc, &c.

Industrial Preparation of Diphenylamine Blues.—Dr. Paul Schoop.—This valuable paper does not admit of useful abridgment.

MISCELLANEOUS.

University College, Aberystwith.—Dr. H. Lloyd Snape has been elected to fill the Chair of Chemistry rendered vacant by the lamented death of Prof. Humpidge. The new Professor acted for three sessions as Demonstrator of Chemistry at University College, Liverpool. He then resigned this appointment in order to study at the Universities of Berlin and Goettingen, under the direction of Professors Hofmann and V. Meyer respectively. Returning to England he was appointed Director of the Department of Pure and Applied Chemistry in the Manchester Technical School, one of the largest and most successful of such institutions. He possesses the diplomas of D.Sc. (Lond.) and of Ph.D. (Goettingen). Papers describing the results of his investigations of the action of phenyl cyanate upon alcohols and phenols, and of the nature and method of preparing certain cyanates and urethanes, have appeared in the Journals of the English and German Chemical Societies.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened or the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Bell Scholarship.—(Reply to "Inquirer.")—Apply to the Secretary, Pharmaceutical Society, 17, Bloomsbury Square, London, W.C.—G. A. KEYWORTH.

MEETINGS FOR THE WEEK.

MONDAY, 16th.—Medical, 8.30.
TUESDAY, 17th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Society of Arts, 8. "The Colonies and Dependencies of the Netherlands," by A. J. Trendell, C.M.G.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
WEDNESDAY, 18th.—Society of Arts, 8. "Methods of Taking the Ballot," by John Leighton, James Withers, and John Imray.
—— Meteorological, 7. (Anniversary).
THURSDAY, 19th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Royal Institution 3. "The Walker School," by Hubert Herkomer, M.A., A.R.A.
—— Chemical, 8. "On Morindon," by T. E. Thorpe, F.R.S., and W. T. Smith, M.B. (Lond). "Manganese Trioxide," by T. E. Thorpe, F.R.S., and F. J. Hambly. "Contribution to the Theory of the Vitriol Chamber Process," by Prof. Lunge. "Studies in Coal Distillation," by Lewis T. Wright.
FRIDAY, 20th.—Royal Institution, 5. "Diffraction of Sound," by the Right Hon. Lord Rayleigh.
SATURDAY, 21st.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.

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THE CHEMICAL NEWS.

Vol. LVII No. 1469.

THE EXHAUSTION OF VIRGIN SOILS IN AUSTRALASIA.

By R. W. EMERSON MACIVOR, F.I.C., F.R.G.S., F.C.S. &c., Late "Sir William Clarke" Lecturer on Agricultural Chemistry, Victoria, and Principal of the Agricultural Department, Technical College, Sydney. N.S.W.

During the past twelve years I have had ample opportunity for studying, in more than a mere general way, the exhaustion of virgin soils in the Australasian colonies, and, as the only chemist who has systematically investigated the subject at all, perhaps the following short summary of my views may have an interest for scientific agriculturists in the Old World. I hope to publish, in a few months' time, a mass of analytical and practical data in proof of the general statements to which I am here compelled to confine myself.

It is of course well known, even in this country, that large tracts of once very productive land in South Australia, Victoria, and New South Wales, have in comparatively few years become more or less impoverished by the continuous growth, year after year, of wheat, and wheat only. In some cases the areas which, in former years, freely gave an average of 25 and 30 bushels of grain per acre, have become so poor that—even after naked fallowing for a season—they refuse to yield crops which will meet the cost of cultivation.

The light friable soils, derived from one geological formation only or from several formations, which cover vast extents of country in each colony, though usually rich enough in the cineral (or mineral) consituents of plant-food, are, except when in moist and sheltered places, singularly deficient in the rich nitrogenous humus which is the main cause of the high fertility of otherwise good land. If this deficiency is not very apparent when the ground is in a virgin state, it becomes so soon after it has been cleared and put under cultivation in the usual primitive fashion. In a lesser degree the want of humus is very noticeable in soils which are of heavier character, and generally traceable to the lower and upper silurian formations, and to the primitive rocks. The rich, deep, red and dark chocolate soils derived from the basaltic and volcanic rocks are not wanting in any of the cineral elements of plant-nourishment, and contain in their virgin state a much larger store of humus than soils of any other kind.

Speaking generally the soils of New Zealand, Tasmania, and the cooler parts of Australia contain more nitrogenous vegetable matter, or rather total nitrogen, than soils of the same formation existing where there is comparatively little rain, and, for the great part of the year, a high temperature.

I may at once state that the exhaustion of the wheat areas is due, with few if any exceptions, to the more or less complete removal of the supplies of nitrogen originally present in the soil chiefly as a constituent of humus.

The ordinary systems of farming followed in the wheat districts, in each of the three Australian colonies under notice, certainly do not tend to economise the soil-nitrogen. The ground is rarely ploughed deeper than 2½ or 3 inches, and the continued passage of the sole of the plough at this depth, season after season, ultimately causes the formation of a compact "pan" at the bottom of the furrows, which is more or less impenetrable to roots of the plants. Hence the naturally deep-rooting wheat is sooner or later made to live as a "surface feeder" in the thin layer of tilled soil resting on the compacted subsoil. In localities where the soil is at all "clayey"—as when of silurian or granitic origin—this "pan" becomes almost rock-like in hardness, and examination will often show that it has been penetrated by the roots of the cereal only to a very small extent. Now the repeated turning up of the mere surface of the ground, particularly when it is light and friable in character, to the hot dry atmosphere which prevails for most part of the year in all the great wheat areas, not only keeps the soil too dry, but causes the speedy oxidation of the humus and a consequent waste of nitrogen. It is by no means uncommon to find a greater proportion of humus in the undisturbed subsoil than in the soil which has been frequently turned over by the plough. But this is not the only way in which the amount of nitrogenous humus is reduced in the soils. In many places in Victoria, and in all the cereal growing districts of South Australia, the wheat crops are not harvested in the ordinary way, but are only "stripped" of the ears and the straw burnt where it grew. This seemingly ruinous, but unavoidable, system must certainly diminish the nitrogenous humus in the surface soil, and thereby hasten infertility.

Numerous arguments in support of my belief are deducible from the results of field experiments made at my suggestion, or under my immediate direction, in many different places, and from the experiences of hundreds of intelligent farmers; but the limited space at my disposal will not permit of my enumerating them to the extent that I should like. One or two points may, however, be referred to:—(1) It has been found that soils poor in humus are sure to give thinner crops than those of the same formation in which humus, and therefore nitrogen, occurs in fair quantity. (2) It is the general practice, in most places, to throw land which shows indications of exhaustion into naked fallow, and the original fertility is certainly in part restored by the operation, but after some years—and particularly where the soil is of light quality—the benefits of fallowing become less marked, owing, in my opinion, to the loss of humus, and therefore of nitrogen. (3) The liberal use of non-nitrogenous fertilisers has been tried on the impoverished soils of Victoria, South Australia, northern New Zealand, and Tasmania, without good effect on the yield of the wheat-crop, for which it was put into the land. In the first-named colony I have known over 1000 tons of first-class phosphatic guanos—non-nitrogenous or nearly so—to be used in one year, on all classes of impoverished ground, without the wheat-crops being, even in a single instance, perceptibly benefited either in quantity or quality. Neither had non-nitrogenous superphosphate, even when containing 28 per cent soluble phosphate, any very marked influence on the crops. Potash, as sulphate and as chloride, either separately or in conjunction with superphosphate, also gave negative results. Top-dressings of nitrate of soda invariably improved the yield of both grain and straw, but never to the extent of giving a substantial profit on the outlay. Sulphate of ammonia, blood manure, bone-dust, and ammoniacal guanos, each gave a more or less satisfactory return according to the quantity and form of nitrogen it contained. (4) Experience in the West-Bourke district, in Victoria, has proved that an occasional pea crop is a sure restorer of fertility to an impaired wheat soil. It is well known to everybody who has the most rudimentary knowledge of farming that leguminous crops are good precursors of wheat in a rotation, and that beans and red clover are the best of these. In Australia neither of the latter is known as a general field crop; indeed red clover does not thrive at all,—in fact does not seed, though in places it yields abundance of flowers,—but in the Mata Mata district, in northern New Zealand, Mr. J. C. Firth has, after much praiseworthy effort and a great outlay of time and money, succeeded in extensively introducing red clover as a preparatory crop for wheat. In the West Bourke district peas is the crop which has for many years been sown as a precursor for the cereal, and the results have been so eminently successful that the practice has been adopted

in many localities throughout those parts of each colony where the markets and other circumstances have proved favourable to its being followed. The increased yields of grain obtained after peas can only be attributed to the large quantity of nitrogen in the form of root-residue and fallen leaves which are left in the soil for the use of the wheat.

In concluding this short paper on a great subject I may say that many of the diseases that have afflicted, and still afflict, the wheat and other graminaceous crops throughout Australia have been foolishly set down to the exhaustion of the soil in one or other of the constituents of plant-food. Thus "red-rust" is often attributed to this cause, as also has been the red fungus which attacks the sugar-cane in some parts of New South Wales and Queensland. Now, as a matter of fact, both these forms of fungi do most harm where the crops are most luxuriant, and therefore where the soils are richest. To my certain knowledge thin wheat crops, growing on naturally poorish or impoverished ground, are least troubled with "red-rust."

THE ACTION OF SULPHUR AND SULPHUR CHLORIDE ON OILS.

By THOMAS T. P. BRUCE WARREN.

I PROPOSE to consider the historical bearing of this interesting subject, more especially as I find under the article "Linseed Oil" ("Watts's Dictionary," vol. iii., p. 703) a few important statements which as they stand are misleading, or at least require supplementing.

Alexander Parkes, in 1846, took out a patent for vulcanising india-rubber, by what is now known as the "cold curing process." As the "curing" or "vulcanising" is confined to the surface of rubber goods, it is more correctly called "surface curing." In the same patent he claimed the action of these "changing agents" on animal and vegetable oils. In a disclaimer he abandoned the parts contained in his provisional specification relating to animal oils. I shall return to this on a future occasion. "On mixing 15 to 25 parts *chloride of sulphur* with 100 parts linseed oil, caoutchouc-like products are obtained, which are the harder the more chloride of sulphur they contain, and are not attacked by moderately dilute acids and aqueous alkalies, but are ultimately saponified by concentrated alkalies. They become brown at 120° C., and blacken and melt at a higher temperature. The addition of 5 per cent chloride of sulphur thickens linseed oil, but does not cause it to harden; the product still retains the solubility of the fatty oils. When to a solution of 1 part linseed oil in 30 or 40 parts carbon disulphide, a quantity of chloride of sulphur is added equal to one-fourth the weight of the oil, the mixture remains fluid for some days, and dries to a varnish on wood." (Perra, *Comptes Rendus*, xlvii., 878; see also *Comptes Rendus*, xlvii., 972).—"Watts's Dictionary," Art. "Linseed Oil," *supra*.

Now a very great deal will depend on what the sulphur chloride itself is, the temperature at which it is mixed with the oil, and also the solvent with which the chloride is mixed. If a large quantity of carbon disulphide be used, or any easily volatile solvent on which the chloride has no action, it is a mere matter of expelling the solvent; as soon as a certain degree of concentration is reached it acts, with a rise of temperature, which facilitates its action and expels the solvent. If a solvent be used with a high boiling-point, the action of the chloride *seems* to be arrested, or modified, even if a substance be present on which the chloride will act in an ordinary way, as on linseed oil. The addition of a small quantity will thicken linseed oil, which thickening is due to the altered oil dissolving in the unaltered oil; but if the oil *perfectly acted on*, so as to yield a solid product, be added to any quantity of oil it does *not* dissolve.

In applying this agent as a quantitative test for oils of this class (drying oils), which may be mixed with a large quantity either of a non-drying oil or animal oil or fat, as well as vegetable fats, I add a certain quantity of a known oil, so that the drying oil present, *plus* the added oil, will be relatively large, compared to the amount of non-drying oils, &c.

A drying oil, under the same conditions and applying the reagent in the same way, will yield the same quantity of solid, non soluble product; when treated with carbon disulphide, this solvent will remove also uniform quantities of extracted matters, oils, &c.

Turpentine, rosin oils, or mixtures of these, are acted on in the same way; a high-boiling petroleum does not even retard the action. When these are mixed with drying oils they can be separated from them after the action of the chloride, as their products are quite soluble in carbon disulphide: this liquid is preferable to petroleum spirit for this purpose, as it exerts a greater softening action on the oil product. I have still this important reaction under consideration, which I hope to refer to at a future time in connection with adulterations of turpentine.

The addition of an excess of sulphur chloride to an oil will give a smaller yield of solid product than if such excess be avoided. We here meet with a difficulty which can be to a very great extent avoided if we have a fair idea of the oil we are operating on, but if we have not it is best to add a few drops of chloride to the disulphide extract, evaporate, and treat as before, avoiding, in such cases, a large excess, especially at first.

When dealing with a mixture of two oils, each of which give solid products, an approximation may be made as to the proportion of each oil present, which should be verified by careful experiment on known mixtures of these oils.

A few facts have already been revealed which establish the value of this reagent; amongst others, I find that lard oil is now largely met with which does not contain lard in any form. Olive oil is most fraudulently dealt with; in many cases adulteration is not even attempted, but it is simply substituted by another oil. Lucca oil is, with no disguise, a product of Hull manufacture. Colza oil is met with which does not contain oven one-third part refined rape oil. Turpentine is disgracefully adulterated with a mixture of rosin oil and petroleum, which is so ingeniously made that the fractions from these with turpentine give a mixture closely agreeing in density and boiling-point with pure turpentine. Even lard itself is frequently met with which contains vegetable stearines obtained in the manufacture of oleo-margarine.

Genuine lard oil is not affected so as to yield a solid product; it is a common thing to obtain a perfectly solid product from American lard oil. English oil is almost as bad. The colour of the American product, after washing with disulphide, shows that it is the same oil which is sometimes offered as almond oil; most probably it is a mixture containing arachis oil; vegetable stearines are added to produce thickening.

These solid products vary in colour with each oil, the conditions even of the same oil, where marked alterations are visible, give corresponding and highly characteristic products; thus the "blown" rape oils and cotton oils are at once detected from ordinary rape, colza, or refined rape oil or ordinary cotton oil; rape oil, poppy oil, and others are recognised without difficulty.

Castor oil, as supplied for lubricating, is an interesting but curious compound. Does this article, as well as the olive oil, find their way into pharmacy?

I give a few results obtained with some of these oils, and hope to supplement this with others in my next:—

Colza Oil, 5 grms. 1 c.c. chloride, diluted with CS_2.

Sample A yielded 6·320 grms.
" B " 6·325 " Product white.

Rape Oil, same as Colza oil.

Sample A yielded 6·235 grms. } Mean 6·208; products
„ B „ 6·301 „ } white.

Blown Rape Oil, same as above.

Sample A yielded 6·070 grms. } Mean 6·095; products
„ B „ 6·120 „ } dark, almost black.

Linseed Oil, 5 c.c. oil and 5 c.c. chloride, with CS_2

Sample A yielded 6·990 grms. }
„ B „ 7·021 „ } Mean 7·035; products
„ C „ 7·095 „ } dark.

These are ordinary results, without special precautions, and obtained with oils delivered some months apart. I have used this reagent for nearly twenty-five years, and have never found reason to suspect its accuracy.

THE DETERMINATION OF CARBON IN STEEL.

By BERTRAM BLOUNT.

Towards the close of 1884 I had occasion to determine the carbon in a sample of steel, which, when treated by the ordinary plan of solution in cupric sulphate, went up very slowly.

Having also tried the electrolytic method without much success (owing perhaps to the form in which the metal was, viz., turnings), I strove to devise some process that should fulfil the requirements of such cases as that with which I was dealing.

It occurred to me that it might be feasible to estimate the carbon in a steel by dissolving the metal in dilute acid, passing the evolved gases over red-hot copper oxide and weighing the CO_2 produced. I was at the time unaware that the very same plan had been recommended by Fresenius (*vide* Crookes's "Select Methods," 2nd edit., p. 145), so that I then regarded my work as original,—nor did this information reach me until after the completion of the investigation.

I will at once say that in my hands the method was a failure, for a reason that will be stated below; but the recording of failures is not wholly useless, even if only to point out the whereabouts of a "No Thoroughfare."

The apparatus used was as follows, and was placed in the order given:—

(1) A gasholder containing nitrogen.

(2) A wash-bottle of caustic potash, to free the nitrogen from traces of CO_2.

(3) The flask in which the steel was dissolved. This was provided with a three-holed cork carrying a tap-funnel for the introduction of the acid, an inlet tube for the nitrogen, and an outlet for the gases evolved by the solution of the steel.

(4) Some simple arrangement for condensing the steam given off on boiling the contents of the flask at the close of the operation, and either returning it to the flask or catching it in a bulb or U-tube.

(5) A calcium chloride tube.

(6) A piece of combustion tube, 6 or 8 inches long, filled with copper oxide, and heated by a small furnace.

(7) An empty U-tube, to catch most of the water formed by the oxidation of the hydrogen—free and combined—given off by the solution of the steel in the acid.

(8) A calcium chloride tube to complete the removal of the water mentioned in (7).

(9) A weighed potash bulb and drying tube, for the collection of the CO_2.

(10) A guard tube.

The following was the method of procedure:—

A weighed quantity—generally about 6 grms.—of the steel was placed in the flask, the tube of copper oxide heated to redness, the potash bulb weighed and attached, all joints ascertained to be tight, and then nitrogen passed briskly through the whole apparatus until the air was judged to have been expelled.

The flow of nitrogen was then almost stopped and about 70 c.c. of dilute sulphuric acid, 1 : 4 by vol., run in through the tap-funnel on to the steel.

The evolution of gas went on steadily, and, when it showed signs of slackening, was aided by gently warming the flask.

When solution was complete the flow of nitrogen was increased, and the contents of the flask boiled for some minutes.

The potash bulbs were then disconnected and weighed.

The solution generally took about two hours, though in the later experiments this time was reduced to but little over an hour without difficulty.

The heating and passing of nitrogen occupied another twenty or thirty minutes.

The insoluble matter in the flask was of course carbonaceous, and the carbon it contained was in all cases determined by the chromic acid method.

In the first set of experiments a steel which we will call A was used.

The results were not concordant, and were without exception lower than the percentage given by Ullgren's method, as the appended Table will show:—

Results with Steel A.

	Parts per cent.		
	Carbon as gaseous Hydrocarbons.	Carbon left as an insoluble residue.	Total Carbon.
Ullgren's method ..	—	—	0·687
Method now on trial:—			
Determination 1 ..	0·512	0·079	0·591
„ 2 ..	0·611	0·071	0 682
„ 3 ..	0·487	0·091	0·578
„ 4 ..	0·433	0·032*	0·465

A piece of cast-steel, B, containing a larger percentage of carbon (tool-steel) was made the subject of another set of experiments.

The results were also discordant, and showed a tendency to be lower than the truth.

Results with Steel B.

	Parts per cent.		
	Carbon as gaseous Hydrocarbons.	Carbon left as an insoluble residue.	Total Carbon.
Ullgren's method ..	—	—	1·169
Method now on trial:—			
Determination 1 ..	0·902	0·098	1·000
„ 2 ..	0·979	0·207	1·186†
„ 3 ..	0·875	0·064	0·939

I attribute the irregularity which characterises both sets of results to the formation of liquid hydrocarbons, varying in quantity according to slight differences in the temperature or rate of solution, which hydrocarbons escape, (partially at least), being carried on by those which are gaseous and subsequent oxidation by the copper oxide, and, on the other hand, are filtered off from the solid carbonaceous residue in the flask, and therefore also escape oxidation in the final treatment with chromic acid.

A greater measure of success might probably be attained by boiling off most of the water in the flask after solution had been effected, and—instead of condensing it—leading it through a tube kept slightly above 100°, so as to retain it all as steam, and in that state allowing it to enter the copper oxide tube, bearing with it the less volatile hydrocarbons.

I may remark, with regard to any method which is based

* In this instance the residue was washed with water, alcohol, ether, alcohol, and water, in the order named, to remove any liquid hydrocarbons, which may account for the low result.

† I cannot account for this high result.

on the solution of the steel in cupric sulphate, that the rate of solution is increased, and the deposit of copper which is left with the carbonaceous matter materially diminished, by the following simple plan:—

A weighed portion of the steel is placed on a platinum plate, at the bottom of a beaker containing the usual solution of cupric sulphate, and is connected with the + pole of one or two Daniell cells.

The other pole is connected with a copper plate which is suspended in the beaker a short distance above the pieces of steel.

As the steel dissolves in the cupric sulphate and throws down copper, so is that copper by the action of the current, re-dissolved, carried across to the cathode and deposited there. By keeping the current rather smaller than is necessary to remove the copper as fast as it is deposited, all risk of oxidising the carbon is obviated.

The carbon is finally left mixed with only a small quantity of copper, so that its removal by cupric chloride before oxidising by chromic acid (if that method be employed) is rendered unnecessary, thus materially saving time and labour.

The principle of the method is identical with that known as Weyl's, but it has two not inconsiderable advantages:—

(i.) That a tedious adjustment of the current so as to avoid oxidation of the carbon, on the one hand, and escape of gaseous hydrocarbons on the other, is not required; and—

(ii.) That the form in which the sample exists is almost a matter of indifference.

I hope to publish shortly a few results bearing on the composition of the gaseous hydrocarbons which are evolved by the solution of steel in dilute sulphuric acid.

Laboratory, Broadway, Westminster,
January 9, 1888.

METHODS OF DETERMINING POTASH.*

Method of Lindo as Modified by Gladding.

(1) *Superphosphates.*—Boil 10 grms. of the fertiliser with 300 c.c. of water for ten minutes. Cool the solution; add ammonia in slight excess, thus precipitating all phosphate of lime, oxide of iron, and alumina, &c., make up to 500 c.c., mix thoroughly and filter through a dry filter; take 50 c.c. corresponding to 1 grm., evaporate nearly to dryness, add 1 c.c. of dilute H_2SO_4 (1 to 1), and evaporate to dryness and ignite to whiteness. As all the potash is in form of sulphate, no loss need be apprehended by volatilisation of potash, and a full red heat must be used until the residue is perfectly white. This residue is dissolved in hot water plus a few drops of HCl; 5 c.c. of a solution of pure NaCl (containing 20 grms. NaCl to the litre) and an excess of platinum solution (4 c.c.) are now added, and the whole evaporated as usual. The precipitate is washed thoroughly with alcohol by decantation and on filter, as usual. The washing should be continued even after the filtrate is colourless. Ten c.c. of the NH_4Cl solution prepared as above are now run through the filter. These 10 c.c. will contain the bulk of the impurities, and are thrown away. A fresh portion of 10 c.c. NH_4Cl is now run through the filter several times (five or six). The filter is then washed thoroughly with pure alcohol, dried, and weighed as usual. The platinum solution used contains 1 grm. metallic platinum in every 10 c.c.

(2) *Muriates of Potash.*—In the analysis of these salts an aliquot portion, containing 0·500 grm., is evaporated with 10 c.c. platinum solution plus a few drops of HCl, and washed as before.

(3) *Sulphate of Potash, Kainite, &c.*—In the analysis of these salts an aliquot portion containing 0·500 grm. is taken, 0·250 grm. of NaCl added, plus a few drops of HCl, and the whole evaporated with 15 c.c. platinum solution. In this case special care must be taken, in the washing with alcohol, to remove all the double chloride of platinum and sodium. The washing should be continued for some time after the filtrate is colourless. Twenty-five c.c. of the NH_4Cl solution are employed, instead of 10 c.c., and the 25 c.c. poured through at least six times to remove all sulphates and chlorides. Wash finally with alcohol, dry, and weigh as usual.

To prepare the washing solution of NH_4Cl, place in a bottle 500 c.c. H_2O, 100 grms. of NH_4Cl; shake till dissolved. Now pulverise 5 or 10 grms. of K_2PtCl_6, put in the bottle, and shake at intervals for six or eight hours; let settle over night; then filter off liquid into a second bottle. The first bottle is then ready for a preparation of a fresh supply when needed.

Alternate Method.

Pulverise the fertiliser (200 or 300 grms.) in a mortar; take 10 grms., boil for ten minutes with 200 c.c. water, and after cooling, and without filtering, make up to 1000 c.c., and filter through a dry paper. In this method, in case the potash is contained in organic compounds, like tobacco stems, cotton-seed hulls, &c., the substance is to be saturated with strong sulphuric acid and ignited in a muffle to destroy organic matter. If the sample have 10 to 15 per cent K_2O (kainite), take 50 c.c. of the filtrate; if from 2 to 3 per cent K_2O (ordinary potash fertilisers), take 100 c.c. of the filtrate. In each case make the volume up to 150 c.c., heat to 100°, and add, drop by drop, with constant stirring, slight excess of barium chloride; without filtering, in the same manner, add barium hydrate in slight excess. Heat, filter, and wash until precipitate is free of chlorides. Add to filtrate 1 c.c. strong ammonium hydrate, and then a saturated solution of ammonium carbonate until excess of barium is precipitated. Heat. Add now, in fine powder, 0·5 grm. pure oxalic acid or 0·75 grm. ammonium oxalate. Filter, wash free of chlorides, evaporate filtrate to dryness in a platinum dish, and, holding dish with crucible tongs, ignite carefully over the free flame below red heat until all volatile matter is driven off.

The residue is now digested with hot water, filtered through a small filter, and washed with successive small portions of water until the filtrate amounts to 30 c.c. or more. To this filtrate, after adding two drops of strong hydrochloric acid, is added, in a porcelain dish, 5 to 10 c.c. of a solution of 10 grms. of platinic chloride in 100 c.c. of water. The mixture is now evaporated on the water-bath to a thick syrup, or further treated with strong alcohol washed by decantation, collected in a Gooch crucible or other form of filter, washed with strong alcohol, afterwards with 5 c.c. ether, dried for thirty minutes at 100° C., and weighed.

It is desirable, if there is an appearance of white foreign matter in the double salt, that it should be washed, according to the previous method, with 10 c.c. of the half-concentrated solution of NH_4Cl, which has been saturated by shaking with K_2PtCl_6, as recommended by Gladding.

The use of the factor 0·3056 for converting K_2PtCl_6 to KCl and 0·19308 for converting to K_2O is continued.

* Official Methods of Analysis of the Association of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

Influence of Molecular Approximation on the Chemical Equilibrium of Homogeneous Gaseous Systems.—MM. Sarrau and Vieille.—Many organic explosives do not contain sufficient oxygen to ensure the complete combustion of their elements. The reaction of decomposition then gives rise in many cases to an equilibrium among the exclusively gaseous products. Experiment shows that this final equilibrium is modified if the weight of the explosive is progressively increased so as to submit the decomposition products to increasing pressures, differing among themselves by several thousand atmospheres.—*Comptes Rendus*, Vol. cv., No. 25.

VALUATION OF INDIGOES.

An Investigation into the Various Methods Employed for the Estimation of Indigotin, together with certain New and Modified Processes.*

By CHRISTOPHER RAWSON, F.C.S.

(Continued from p. 20).

Hyposulphite Method.—This process, which was recommended by A. Müller (*American Chemist*, v., p. 128), depends upon the fact that a solution of sodium hyposulphite reduces sulphindigotic acid quantitatively to disulpho-leukindigotic acid. In speaking of sodium hyposulphite I do not allude to the "hyposulphite" of the photographer, which is really sodium thiosulphate ($Na_2S_2O_3$), but to the sodium salt derived from the true hyposulphurous acid, H_2SO_2. The apparatus required for this operation is perhaps rather elaborate, and considerable care must be exercised in its manipulation; but when all the details are carried out analyses may be performed in a short space of time with very great accuracy. I will describe the method as performed in my own laboratory, though it only differs from Müller's account in a few details, which considerable practice has, in the course of time, led me to adopt with advantage.

1. *Preparation of Sodium Hyposulphite.*—A flask of about 100 c.c. capacity is loosely filled with twisted sheet zinc, which is covered with a solution of sodium bisulphite (sp. gr. 1·30). The flask is corked and allowed to stand for about an hour, when the bisulphite will be found to have lost the smell of sulphurous acid. The liquid is now decanted and well-mixed in a large flask or bottle, with five litres of distilled water, containing in suspension about 50 grms. of recently slaked lime. The vessel is closed to prevent access of air, and, after allowing the insoluble matters to subside, the clear liquid is syphoned off into a convenient store bottle, and about 100 c.c. of petroleum oil are poured on the surface of the liquid to prevent oxidation. The bottle is provided with a cork through which pass two tubes, one of which is in the form of a syphon, and is used to fill the burette; the other tube, which only just passes through the cork, is connected with a supply of coal-gas. A further precaution which I employ in order to preserve the strength of the hyposulphite solution is to cover the bottle with a sheet of black paper.

2. *Standardising the Hyposulphite.*—The solution may be standardised either by pure indigotin or by an ammoniacal solution of sulphate of copper, using, in the latter case, a solution of indigo-carmine as an indicator. Bernthsen pointed out in 1881 (Chemical News, xliii., p. 79) that ammoniacal sulphate of copper alone could not be used for estimating the strength of a solution of sodium hyposulphite, as the solution of sulphate of copper became colourless before it was completely reduced. On this account he proposed that, towards the end of the titration, a few drops of indigo-sulphate solution should be added, by which modification the termination of the reaction could be easily and accurately ascertained. Müller found in his experiments that one molecule of ammoniacal sulphate of copper was decolourised by the same quantity of "hyposulphite" as one molecule of indigotin dissolved in sulphuric acid. My own estimations confirm this statement. The standard solution of copper sulphate is prepared by dissolving 1·904 grm. (equal to 1 grm. indigotin) of the crystallised salt ($CuSO_4.5H_2O$) in a litre of water containing 100 c.c. of strong ammonia (sp. gr. 0·880); 50 c.c. of this solution are measured into a wide-mouthed flask (capacity 200 c.c.), boiled to expel air, and allowed to cool. The flask is provided with a caoutchouc stopper, perforated with four holes, into two of which are fitted two Mohr's burettes, one containing the hyposulphite solution, and the other the indigo-carmine. The two other apertures serve for the entrance and exit of a current of hydrogen or coal-gas. It is essential that the process should be conducted without access of air. The burette containing the "hyposulphite" is furnished with a perforated cork, through which passes a glass tube connected with a supply of coal-gas; and at the lower extremity a glass tube is joined to it, which is in connection with the bottle filled with sodium hyposulphite above mentioned. By this means the burette can be refilled without fear of oxidising the hyposulphite solution. The flask containing the 50 c.c. of copper sulphate is attached to the caoutchouc stopper, and the air is expelled by a current of coal-gas, which should first pass through U-tubes containing ferrous hydrate. The solution of "hyposulphite" is now gradually run in until the liquid becomes nearly colourless, when a few drops of indigo-carmine are added from the other burette, and finally, a further quantity of hyposulphite is added, until the solution assumes a peculiar brownish-red colour. The end of the reaction is sharp and unmistakable. The quantity of hyposulphite which is used to decolourise the few drops of indigo-carmine solution is very small, but by determining the relative strength of the two liquids the amount thus consumed can be easily calculated, and then deducted from the number of c.c. used in the titration of the copper sulphate solution. The 50 c.c. of copper sulphate are equivalent to 0·05 indigotin, so that supposing 25 c.c. of sodium hyposulphite have been required for the titration, each c.c. of the hyposulphite will correspond to 0·002 indigotin.

3. *Titration of Indigo-Sulphate.*—The operation is performed in a similar manner to that just described. From 0·75 to 1·25 grm. of finely-powdered indigo is mixed with ground glass and dissolved in sulphuric acid as previously stated in detail. The sulphindigotic acid is diluted to 1 litre and filtered; 50 c.c. of the filtrate are measured into a flask, boiled to expel air, and allowed to cool. The flask is then attached to the burettes, and after driving out the air by a current of coal-gas the "hyposulphite" solution is gradually added, during constant agitation. With indigotin and the better qualities of indigo the liquid, when fully reduced, becomes of a pale yellow tint, but with inferior samples the solution is more or less of a dirty brownish-yellow colour. In both cases, however, the end of the reaction is quite clear and distinct.

Action of Sodium Hyposulphite upon the Constituents of Indigo other than Indigotin.—A series of experiments were performed similar to those described under the permanganate method. It was found that neither indigo-gluten, indigo-brown, nor indigo-red had any appreciable effect upon the estimation of indigotin by sodium hyposulphite. But there is one possible source of error. If the solution to be titrated contains iron in the ferric state, the results obtained are somewhat too high. I have made experiments with ammonio-ferric sulphate (iron-alum), and found that sodium hyposulphite reduces ferric sulphate, in an acid solution, quantitatively to ferrous sulphate. A few drops of sulphate of indigo were used as an indicator, as in standardising the hyposulphite by means of copper sulphate. I found that the same quantity of hyposulphite solution was required to reduce one molecule of ferric sulphate as to reduce one molecule of sulphate of copper. I am not aware that this reaction has been previously noticed, but it forms a quick and trustworthy direct method for the estimation of ferric iron. A standard solution of ferric sulphate may also be employed, in place of ammoniacal copper sulphate, for determining the strength of the hyposulphite solution.

It is only in the lower classes of indigo that iron is present to any appreciable extent, and in those cases it principally exists, or subsequently becomes reduced to, the ferrous state. The hyposulphite method gives the percentage of indigotin, and does not include indigo-red.

Example III.—50 c.c. standard ammoniacal sulphate of copper (= 0·05 indigotin) required 30 c.c. sodium hyposulphite—

$$\therefore \text{ 1 c.c. hyposulphite} = \frac{0{\cdot}05}{30} = 0{\cdot}00166\dot{6} \text{ indigotin.}$$

* *Journal of the Society of Dyers and Colourists*, No. 4, Vol. I.

1 grm. of Java indigo was dissolved in sulphuric acid and diluted with water to 1 litre; 50 c.c. (= 0·05 indigo) required 20·6 c.c. hyposulphite—

$$\therefore \frac{0{\cdot}00166 \times 20{\cdot}6 \times 100}{0{\cdot}05} = 68{\cdot}64 \text{ per cent indigotin.}$$

(To be continued).

NOTICES OF BOOKS.

Chemistry, Inorganic and Organic, with Experiments. By Charles Loudon Bloxam, Professor of Chemistry in King's College, London; in the Department of Artillery Studies, Woolwich; and formerly in the Royal Military Academy, Woolwich. Sixth Edition. London: J. and A. Churchill.

This edition of Mr. Bloxam's work derives a melancholy interest from the very recent death of the author. The publishers, in a brief note, express their regret of one whom they so highly esteemed and with whom their firm has been associated for more than thirty-four years. They feel, however, a degree of satisfaction—which we also show—that the work had been completed and revised by Professor Bloxam himself before he was seized with his last illness, "so that it is not necessary to add another name to the title-page of this edition."

"Chemistry, Inorganic and Organic," first appeared in 1866, and, notwithstanding the great number of other text-books—some of them unquestionably meritorious—which have since appeared, it has remained in favour both among students and teachers. This is indeed at once made evident from the fact that the publishers found it necessary to issue the edition before us.

The work, we find, has undergone much more than a mere revision; a large part of it has been re-written, to keep it in harmony with the recent advance of chemical science. Of course the portion devoted to organic chemistry has been most completely remodelled. In the earlier editions the composition and properties of bodies were discussed as they presented themselves in the description of industrial operations, an arrangement which rendered it difficult to bring their theoretical relations into sufficient prominence.. This is altered in the present edition. Organic bodies are classified as hydrocarbons, alcohols, aldehyds, acids, ketones, &c.

Of course in a book which does not run to 800 pages not every known compound can be treated in detail, but the descriptions have the merit of being exceedingly clear. It will be perceived that particular attention has been given to explosives, and especially gunpowder, a circumstance due to the fact of the author's long connection with military colleges.

Metallurgy occupies a space perhaps unusual in chemical manuals of the present day, since it is now ordinarily treated of in distinct works.

The most recent discoveries are duly introduced. Thus we find a notice of the isolation of fluorine, and the properties of germanium are described at some extent.

There is an exceedingly elaborate index, extending to upwards of 40 pages, as well as a table of contents. It is necessary for readers to bear in mind that in this table the references are to paragraphs, but in the index to pages.

To attempt any formal judgment on a work which has reached its sixth edition would be not merely an unnecessary but a gratuitous task; but we may safely say that, as it now stands, it is a decided improvement on the former issues, and that it will be found still more useful.

Notes on the Literature of Explosives. By Chas. E. Munroe. No. xiv.

The pamphlet now lying before us contains, amongst other matter, an account of the circumstances attending what has been called "A Remarkable Explosion," which occurred at Brighton, Ill., U.S.A., during a severe thunderstorm.

The magazine contained 50 tons of powder and 15 tons of dynamite. After giving some details of the extent of the damage, certain minor facts that bear on the general subject of explosions are stated and discussed. A consideration of these facts shows that the immediate result of the explosion was to instantly produce a large volume of gas, which crushed everything within a certain radius. The condensation of the surrounding air would naturally free itself in the direction of least resistance, that is to say, upwards, so this condition was confined to a small circle. Fortunately no other magazine, and there were ten others, was situated within this area, so the rest of the dynamite was unaffected by the shock. Beyond this area there was a narrow circle of land with a radius of about fifteen rods where comparatively little injury was done. Outside this area, the movement of the air was towards the point of explosion. This was shown to be the case by the glass in the windows of the more distant dwellings being forced outwards.

It is most remarkable that although one of these magazines was exploded by a flash of lightning in 1880, no precautions in the shape of lightning conductors had been taken; this seems to show either a total disregard of the known laws of electricity, or else a mistaken notion that the conductor attracts the lightning, and thus increases the danger, instead of providing a safe path for the current.

The problem of protecting magazines has been compared to that of the protection of tanks in which petroleum is stored; but this view is quite erroneous; in the case of petroleum tanks there is always a veil of explosive vapour of varying height hanging over and about the tank, so that the difficulty met with is to carry off the current safely before it can reach this column of ascending gas. Gunpowder magazines, on the other hand, offer no such difficulty, and it should be imperative on all owners of such buildings to have them placed under proper protection by some competent man.

Following this is an account of the trials of some new shells, in which the component parts of the explosive are placed in three separate glass vessels. A time fuse is attached, and when the projectile has travelled a certain part of its trajectory a small charge of powder breaks the glasses, and causes their contents to become intimately mixed. On striking a resisting object the force of impact causes the explosion of the compound formed. Before firing this shell is perfectly free from danger.

A note on "Unsuspected Dangers with Frictional Electricity in Blasting," gives an interesting and instructive account of an accident which occurred during some experiments in submarine mining. Two cables were employed to fire the charges, but on the word being given to fire the first mine, both exploded, although the cables were thoroughly insulated one from the other; a careful examination showed that nothing had been tampered with. So another set of experiments was instituted, and it was eventually found that the firing of the second charge was due to induction, and it was furthermore proved that it would be dangerous, on cables running parallel, and within even forty or fifty feet of each other, to employ the frictional machine where more than one charge is connected.

CORRESPONDENCE.

WARNING TO CHEMISTS.

To the Editor of the Chemical News.

Sir,—As one of the Scotch chemists referred to in the timely warning of Ph.D., F.I.C., in Chemical News, vol. lvii., p. 23, I write to say that the individual is not un-

known in Scotland. His information was doubtless derived during a somewhat prolonged tour he appears to have made here last summer. On that occasion I have proof that he visited not only many works' chemists, but lecturers, and even directors of Chemical Companies, there being no limit to his assurance. He seems to have frequently obtained money from charitable people, which on one occasion he was observed to spend on drink. Perhaps his worst characteristic is the *false* and even injurious statements he makes anent those chemists whom he professes to know. It is to be hoped that this correspondence will warn others, and enable them to hand him over to the police.—I am, &c.,

ANALYST, F.I.C., &c.

ANALYSES OF MIXED PAINTS.

To the Editor of the Chemical News.

SIR,—Mr. Fox's criticisms on the method of examining paints, which appeared in the CHEMICAL NEWS (vol. lvi., p. 279), require that I should explain why I recommended this method.

I did not give this as a method of analysis, the results of which have to be *interpreted* in accordance with technical knowledge, but as a process applicable to any ordinary case and to every possible mixture, so far as I am aware. Although the operator may know little about paints, he can obtain results which enable him to speak with as much assurance as if he he had been trained to this business.

Nitric acid was used thirty-five years ago for this purpose, in exactly the same way as given by Mr. Fox; paints were then very different to what we find them now. To the stock in trade of a paint manufacturer we must now include benzine and other fractions of petroleum, rosin and rosin oil, shale spirit, certain metallic oleates and fatty compounds, as well as those resulting from the action of rosin acids on zinc, lead, calcic, and other oxides.

My objection to burning off the oils, &c., is the reduction and loss of lead, turpentine, *et hoc omne genus*, and the volatile compounds of arsenic and mercury. Nitric acid is not satisfactory to use; the oils are recovered in a completely altered form, from which nothing can be ascertained of their nature or previous condition; the same is obtained mixed with insoluble compounds not acted on by nitric acid, and insoluble compounds formed by the action of nitric acid; added to this we have the oxidised products of turpentine, rosin, and rosin oil, although turpentine is separately estimated from the *distilled* product.

Let us assume that this method is used where lead compounds and sulphites of zinc, &c., are present. The bases are partly converted into nitrates, and, although the results are intelligible to one who is fairly acquainted with paints, what is there to guide an outsider? For instance, calcium is found as nitrate and sulphate; the carbonate may be an adulterant of white lead, its oxide may be the base of fatty compounds, or the sulphate may be an impurity in barium sulphate, &c.

The basic oxides, in particular, will act on the oil, and the compounds so formed will dissolve in the solvents I recommend. The weight of oil and soluble fatty acids is increased by the bases combined with the acids, but a subsequent part of the process removes the bases, so that the linseed oil and fatty acids of this oil are recovered together by the sulphur chloride. If we wish to know how much linseed oil existed in combined forms, we can arrive at the same from the bases set free. Sulphur chloride acts not only on the drying oils, but it acts in a similar way on the liberated acids from these oils. The sulphur chloride decomposes the fatty salts, and the acids thus set free are acted on as so much oil, that is, *if they have been obtained from a good drying oil.*

Mr. Fox says that "the turpentine, shale spirit, or petroleum would evaporate with the solvent used for their extraction." Even if they do, which is quite problematical, there is no difficulty in providing for their recovery. Mr. Fox says "the oil is not the *body*-giving material of paints, &c." This sentence is confusing. The oil altered by the pigment is the body-giving medium; pigments alone will not give body any more than barium sulphate.

Sulphur chloride acts on turpentine, rosin, and rosin oils, and converts them rapidly into semi-solid resinous substances, but, being soluble in carbon disulphide, they can be separated from the oil. By carrying out this operation in a retort we can distil over the petroleum, which is unaltered. If rosin or rosin oil be present the action is very violent, and a similar product is obtained, but the colour is so very much darker than is given by pure turpentine that these adulterations are readily apparent.

To confirm the presence of rosin or rosin oil the residue is digested with an alcoholic solution of soda; the chloride will now give a rich ruby resin, instead of a dark, almost black, product. This test has enabled me to fix on the composition of this so-called turpentine, which is very extensively sold.

The addition of petroleum, boiling 270° to 320° F., would reveal itself by the density; hence rosin or rosin oil is added to make the mixture equal to that of turpentine.

The behaviour of this turpentine with sulphur chloride is so characteristic that this fraudulent mixture cannot deceive even an inexperienced person.

If the separation of the ingredients of a paint, as previously indicated, is not required, the process can be immensely shortened, and much information can be obtained in a few minutes of greater value than the nitric acid process can possibly give. Carbon disulphide is added to the paint or pigment ground in oil; to this sulphur chloride is added, when, if the paint is in a good drying condition, it almost instantly dries up on evaporating the disulphide. From the powdered mass—petroleum, resins (including the turpentine and rosin oil)—unaltered oil can easily be removed by carbon disulphide.

Mr. Fox speaks of the errors due to sulphur chloride on oils, &c., as fatal to its value. I am rather surprised at this statement, for an error of 5 per cent in estimating an oil is the limit allowed; it very frequently does not exceed 1 per cent between duplicate tests made on the same oil.

When two oils are mixed together, which are acted on with sulphur chloride, the weight of the product, if the oils themselves are known, will supply the means of saying how much of each oil is present in the mixture. A mixture of poppy oil and linseed oil, examined a few days ago, gave results which showed that these oils were present in equal proportions. What should we have learnt if we acted on a paint made with this, with nitric acid as recommended by Mr. Fox. In cases where the turpentine "*fake*" referred to is met with, what is the value of the distillation process?

What are the changes due to heating turpentine or rosin oil with strong basic oxides at a temperature sufficiently high for their recovery? and yet Mr. Fox is satisfied with this process for the turpentine determination.—I am, &c.,

THOMAS T. P. BRUCE WARREN.

Tamworth Villa, Earlham Grove,
Forest Gate.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cv., No. 25, December 19, 1887.

The Condition of Sulphur and Phosphorus in Plants, the Earth, and in the Mould, and on their Determination.—MM. Berthelot and André.—In plants sulphur occurs as sulphates; in the form of ethereal compounds, comparable to the ethyl-sulphates and glyceri-

sulphates capable of being split up by hydration under the prolonged action of dilute acids or alkalies or by oxidation; in the form of mineral compounds, such as sulphides, sulphites, hyposulphites, &c., convertible into sulphates in the moist way by the prolonged action of oxidising agents, such as nitric acid; in the form of organic compounds, such as taurine, cystine, the sulpho-conjugated acid and albumen compounds, the sulphur in which is not convertible into sulphuric acid in the moist way. The method which the authors employ for determining the total sulphur of plants, &c., with absolute accuracy, is as follows:—The product, previously dried at 100°, is burnt in a column of oxygen, and the resulting vapours are passed through a long column of pure anhydrous sodium carbonate. The authors operate in a tube of hard glass at a temperature bordering upon redness, but insufficient to enable the sodium carbonate to react upon the glass of the tube. When the organic product is completely burnt the current of oxygen is still kept up for some time, maintaining a temperature bordering upon redness, so as to convert the alkaline sulphuretted salts formed at first into sulphates. When this is done the tube is let cool, the contents are dissolved in sufficient water, acidulated with hydrochloric acid, boiled, and the sulphuric acid precipitatd in the ordinary manner. After the removal of the barium sulphate the phosphorus may be separated as a phospho-molybdic compound, or the phosphoric acid may be determined at once in a special portion. Phosphorus exists in plants in the form of phosphates, soluble in water or in dilute mineral acids; in the form of ethereal compounds; as mineral compounds, phosphides, phosphites, or hypophosphites; or in the form of organic compounds of the order of the oxide of triethyl-phosphine, phenyl-phosphoric compounds, or cerebric acid.

At What Degree of Oxidation are Chrome and Manganese in their Fluorescent Compounds?—Lecoq de Boisbaudran.—As regards chrome no sufficiently definite answer is given; the manganese yielded a little less oxygen than if it had been entirely in the state of MnO_2.

Specific Heat of Tellurium.—Ch. Fabre.—Tellurium possesses approximately the same specific heat in its different conditions, at least for temperatures bordering on 100°. It is possible that the difference is intensified at higher temperatures, and in particular when near the point of transformation of amorphous tellurium into the crystalline form.

Study on an English Coal.—MM. Scheurer-Kestner and Meunier Dollfus.—A thermo-chemical examination of a coal from Glamorgan, known as "Nixon's Navigation."

Optical Isomerisms of Cinchonine.—MM. E. Jungfleisch and E. Léger.—The authors, on dissolving pure crystalline cinchonine sulphate in four times its weight of a mixture of equal parts of water and pure sulphuric acid (sp. gr. 1·84), obtained six new bases, which they name cinchonibine, cinchonifine, cinchonigine, cinchoniline (all isomers of cinchonine), and oxycinchonines α and β.

Attempt at a Diagnosis of the Volatile Alkaloids.—Oechsner de Coninck.—(See p. 2).

Moniteur Scientifique, Quesneville.
Series 4, Vol. i., September, 1887.

Novel Reactions of Sugar.—D. Lindo.—From the CHEMICAL NEWS.

Memoirs on a Purple Silver Chloride, Bromide, and Iodide; on Heliochromy and the Latent Photographic Image.—Carey Lea.—From *American Journal of Science* and CHEMICAL NEWS.

Falsification of Oils.—T. Bruce Warren.—From the CHEMICAL NEWS.

Detection and Determination of Thallium in Platinum.—H. N. Warren.—From the CHEMICAL NEWS.

The Lower Oxides of Molybdenum.—Herr W. Muthmann.—Already noticed under *Liebig's Annalen.*

MISCELLANEOUS.

Cheadle Railway, Mineral, and Land Company.—By an advertisement in our columns it will be seen that this Company invite subscriptions for an issue of 1000 £6 per cent Mortgage Debentures of £100 each, repayable at the end of 25 years, at the price of £110 per bond, they reserving the option to repay the bonds at any time during that period, on giving six months' notice, at the price of £115 per bond. Of the capital of the Company (£250,000, in 25,000 shares of £10 each) £100,000 is already subscribed and allotted. The Company is incorporated for the purpose of constructing a line of railway from the town of Cheadle, in Staffordshire, through Draycott-le-Moors to Cresswell Station, a distance of about four miles, for the purpose of developing the Cheadle and Draycott Coal and Iron Field, and for opening up and developing a valuable building estate at Totmanslow. The Prospectus states that by the construction of the railway the vast mineral wealth of the Cheadle and Draycott Coal Fields can be extracted and transported to London and other markets; and it is proposed to erect Brick, Tile, and Drain Pipe Works, for which the Company's land supplies suitable materials.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened or the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Purification of Refuse Waters.—Can any of your readers tell me the methods successfully adopted for treatment of refuse waters from dye works, tanneries, and wool scouring, or refer me to any work dealing with this subject?—J. S.

Leaden Earrings.—(Reply to B. Jones).—Lead has no pernicious ingredient contained therein to wear in ears, but cannot be worked as fine as gold can; hence, rings of gold are worn instead of copper, iron, or tin in European and American communities, for the former metals are so liable to acquire a deposit of verdigris, which causes blood poisoning. Hence persons who wear earrings prefer gold or silver ones for safety. Several cardinals have worn earrings, and at the Duke of Norfolk's marriage, November 21st, 1877, earrings were worn by several gentlemen who were guests thereat; probably some heraldic custom, his Grace being Earl Marshal. These ornaments were golden wires, and worn by these parties with gravity.—MARY SHOONEN.

MEETINGS FOR THE WEEK.

MONDAY, 23rd.—Medical, 8.30.
TUESDAY, 24th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
WEDNESDAY, 25th.—Geological, 8.
—— Society of Arts, 8. "Theatres and Fireproof Construction," by Walter Emden.
THURSDAY, 26th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Telegraphic Engineers, 8.
—— Royal Institution, 3. "My Visits to America," by Hubert Herkomer, M.A., A.R.A.
FRIDAY, 27th.—Quekett Club, 8.
—— Society of Arts, 8. "The Public Health in India," by Mr. Justice Cunningham, of the High Court of Judicature, Calcutta.
—— Royal Institution, 9. "The Exploration of Masai-Land," by Joseph Thomson, F.R.G.S.
SATURDAY, 28th.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.
—— Physical Society, 3. "The Effect of Magnetisation on the Thermo-electrical Properties of Bismuth," by Herbert Tomlinson. "The Influence of Magnetism and Temperature on the Electrical Resistance of Bismuth and its Alloys with Lead and Tin," E. Van Aubel. "On a Water-dropping Influence Machine; and on the Price of the Factor of Safety in Lightning Rods," Prof. S. P. Thompson.

THE CHEMICAL NEWS.

VOL. LVII No. 1470.

ON SOME AUSTRALIAN INDIGENOUS SALINE FODDER-PLANTS.

By R. W. EMERSON MACIVOR, F.I.C., F.R.G.S., F.C.S., &c.

IN some of the inland pastoral areas of Australia, where the soils and waters are more or less saline in character, the ground is covered, not with grass, but for most part with "scrubby" vegetation consisting of several varieties of the *Atriplex* family, and known as "salt-bush" upon which sheep not only thrive wonderfully well, but experience an immunity from diseases of all kinds, unknown in even the richest grass districts. A few years ago Mr. J. Everett, an extensive sheep-owner in Victoria and New South Wales, sent me some specimens of two kinds of salt-bush (*Atriplex speciosus* and *A. campanulata*) growing on one of his newly-acquired properties, with the request that I should report upon their nutritive qualities. The following are my analyses so far as I had time or occasion to carry them :—No. 1 is the average of two analyses and No. 2 of four analyses of thoroughly dry samples.

	No. 1. *A. campanulata.*	No. 2. *A. speciosus.*
Carbohydrates	43·16	42·25
Fibre	12·68	15·48
Albumenoids	14·35	13·70
Fat	2·21	2·20
Ash	27·60	26·61
	100·00	100·26

The ashes (less CO_2) had the following centesimal composition :—

	No. 1.	No. 2.
K_2O.	19·17	22·43
Na_2O	34·75	38·92
MgO	7·05	6·12
CaO.	16·40	13·26
Fe_2O_3	1·55	1·40
P_2O_5	4·62	3·96
SO_3.	3·29	2·44
SiO_2.	2·93	4·14
$Cl(Cl_2-O=55)$	10·25	7·28

The percentage of chloride of sodium in the ash of different samples of each variety varies very much, being sometimes only 2 or 3, and occasionally as high as 38 or even 40.

The most remarkable peculiarity of these plants is that they contain more than twice the average quantity of ash found in any other known plants.

Their high value as fodder for sheep is due to the proportion of carbonaceous and albuminous nutrients they contain, and also to the chlorides and potash which serve to aid digestion and the production of "suint."

NOTE ON MR. ALLEN'S METHOD FOR THE DETECTION OF HOP-SUBSTITUTES IN BEER.

By J. O. ARNOLD.

SOME months ago Mr. A H. Allen, President of the Society of Public Analysts, read before that body a Paper (since published in abstract form in the *Journal of the Chemical Society*) in which he announced, with no uncertain voice, that he had discovered a process by which the bitter principles of hop-substitutes—such as quassia, chamomiles, chiretta, &c.—could be with ease and certainty separated from hop-bitters. This process (which is merely a slight modification of a very ancient method) Mr. Allen carries out as follows :—One litre of beer is evaporated to 300 c.c.; the hot liquid is treated with neutral acetate of lead, filtered hot, and if necessary cooled; the excess of lead is thrown down by means of H_2S, and the filtrate is concentrated to 150 c.c. Mr. Allen states that by this treatment "*the hop-resin and lupulin are completely precipitated, while all, or nearly all, hop-substitutes remain in solution.*" The italics are Mr. Allen's.

The concentrated filtrate from the lead sulphide is acidified with sulphuric acid, and is then extracted with chloroform, next with ether, and finally, if necessary, with a mixture of both after liberation of alkaloids with ammonia. Then, according to Mr. Allen, and he again uses italics, "*the presence of some hop-substitute is certain if the chloroform or ether residue has a marked bitter taste.*"

Recently the writer had occasion to test the value of this method, and the results obtained were so suspicious that the matter was further investigated. The following trials were carried out with the utmost care.

Experiment 1.—An infusion of 5 grms. of hops was made in 300 c.c. of water. To the hot filtered liquid an excess of normal lead acetate was added, the resulting precipitate was filtered off, and the filtrate allowed to become cold. No further precipitation took place. The excess of lead was removed with H_2S, and the filtrate from the sulphide was evaporated to low bulk, rendered acid with a few drops of dilute H_2SO_4, and was twice extracted with its own volume of chloroform. On evaporating off the latter *an intensely bitter residue was obtained.* The aqueous liquid was next treated with ether, and the residue obtained was also distinctly bitter.

Experiment 2.—Proceeded as in Exp. 1, using, however, basic acetate. The same results were obtained. In this case the liquid required filtering twice, as a further precipitation took place when the fluid became cold.

Experiment 3.—In order to carry out the process under the exact conditions met with commercially, 1 pint of malt was crushed and digested with 2 pints of ordinary water, for two hours, at about 70° C. The wort was strained through muslin, and was boiled with ¼ oz. of hops. The liquid was cooled to 20° C., and a little brewer's yeast was added. After fermenting 18 hours the fluid was filtered, and was found on analysis to contain 2·38 per cent. of alcohol. One litre of this beer (concerning the purity of which there can be no question) was treated exactly in accordance with Mr. Allen's instructions for carrying out his process. *The residue from the chloroform was most bitter, and water shaken with it and dropped on the tongue yielded a bitter taste persistent for about an hour.*

It is quite evident that Mr. Allen's process is misleading, and that the bitter of the hop is *not* completely precipitated by either basic or neutral acetate of lead.

The Laboratory, 34, Bank Street, Sheffield,
January 16, 1888.

NEW METHOD FOR THE ANALYSIS OF THE NITRITES.

By A. VIVIER.

ON treating an amide, such as urea, with nitrous acid, these two substances are mutually decomposed, with the liberation of nitrogen, water, and the acid corresponding to the amide. This reaction was discovered by Millon, who employed it for the determination of urea in urine. He passed the gases through a weighed Liebig's tube containing caustic potash, and he calculated the weight of

the urea from the weight of the carbonic acid. The author has applied the same reaction to the determination of nitrites, absorbing the carbonic acid, and measuring the nitrogen set free.

It must be remarked that we always collect double the nitrogen contained in the substance to be determined, which is an excellent condition, even if an excess of urea is employed. The process consists in treating the solution containing the nitrite with urea and sulphuric acid, in suitable conditions, passing the gases into an alkaline lye, and determining the volume of the nitrogen. The apparatus consists of a flask holding about 150 c.c., fixed above a Bunsen burner, and closed with a cork having three perforations. One of these admits a tube which introduces a current of pure carbonic acid during the whole time of the operation; the second admits a funnel fitted with a tap for the introduction of the reagents, and the third receives the lower end of a Liebig's condenser, acting *per ascensum*. The other extremity of the condenser communicates with the potash apparatus devised by M. Dupré for the determination of nitrogen in a modification of the Dumas method.

The first step is to expel all air from the apparatus by boiling a little water put in the flask and introducing a current of carbonic acid. The condensed steam returns to the flask in consequence of the arrangement of the condenser.

When the air has been expelled the author introduces successively into the flask, by means of the funnel, the solution containing the nitrite, the requisite quantity of urea dissolved in a little water, and finally, dilute sulphuric acid. The reaction is effected with the aid of heat, and the gases evolved are carried into the potash apparatus by the current of carbonic acid. The liquid is kept at a boil during the entire process. The carbonic acid is entirely absorbed in the potash-ley, and the nitrogen remains pure. The current of carbonic acid is kept up, so that no nitrogen may remain in the apparatus. When this is effected the nitrogen is passed into a jar and measured with the usual precautions. Neither the organic matters of soils nor the nitrates interfere with the reaction.—*Comptes Rendus* (vol. cvi., p. 138).

VALUATION OF INDIGOES.

An Investigation into the Various Methods Employed for the Estimation of Indigotin, together with certain New and Modified Processes.*

By CHRISTOPHER RAWSON, F.C.S.

(Concluded from p. 30).

II. *Sublimation.* — According to Crum, indigo-blue volatilises in open vessels at about 288° in dark purple-red vapours: in closed vessels it decomposes partially when heated. According to Dumas, it volatilises without decomposition only in a current of air or *in vacuo*: the powder dropped on a piece of heated platinum foil volatilises in purple vapours, without leaving a residue, each particle being supported by the vapour, without coming in contact with the foil.

Mr. Charles Tennant Lee (Chemical News, Aug. 1, 1884)† has used a method of sublimation for several years which, in his hands, has yielded most satisfactory results. He employs for this purpose shallow platinum trays, 7 c.m. long, 2 c.m. wide, and 3 to 4 m.m. deep. About 0·25 grm. of finely-powdered indigo, which has been previously dried at 100°, is weighed into the tray and spread in an even layer over its surface. The operation is conducted on an iron plate, which is heated gradually to avoid burning. When the surface of the indigo is covered with a shining mass of crystals, a piece of sheet iron, bent into the form of a low flat arch, is placed over the platinum tray, and, at the same time, as the temperature rapidly rises, the gas is turned down. The vapours of indigotin are now given off, and the heat is gradually raised; but care must be taken lest any yellowish vapours appear, which would indicate the evolution of bodies other than indigotin. When all the crystals of indigotin have disappeared from the surface of the residue, the tray, with its contents, is cooled in a desiccator and weighed. The loss in weight is indigotin. Mr. Lee says that the time required for a 50 per cent indigo is thirty to forty minutes, but soft Java indigo sometimes requires two hours. He also adds that results obtained by this method are constant within 0·25 per cent, but frequently he has made redeterminations, with variations of only half that error.

At first sight, this method appears remarkably simple, combining accuracy with a fair degree of quickness. I have not seen the original paper, but, according to the abstract in the Chemical News, Mr. Lee does not show any figures by which his method can be compared with other recognised processes for estimating indigotin. Indigo contains a variety of substances whose properties have not as yet been thoroughly investigated. I have found that indigo-gluten (including other substances soluble in dilute acid), indigo-brown, and indigo-red are all more or less affected by this process of sublimation, and, furthermore, that pure indigotin (prepared either by Fritzsche's method or by crystallisation from aniline) is partially decomposed, and leaves a dark-brown residue, amounting to upwards of 10 per cent, varying in quantity according to the physical condition of the indigotin operated upon, and also according to the length of time required for the operation. However, it will be seen, on reference to Table II., that in some cases results have been obtained agreeing very closely with those obtained by reduction methods; but, as a rule, inferior qualities of indigo, containing much matter soluble in hydrochloric acid, yield results by this process which are too high; whilst, on the other hand, indigoes rich in indigotin give results which undoubtedly are too low. When performed under the same arched cover, I have frequently obtained, in a given sample of indigo, almost identical results, but when the two analyses have been made under different covers, I have repeatedly found a difference of upwards of 2 per cent in the same sample. It is scarcely necessary for me to add that the estimation of indigotin by sublimation involves a determination of water in the sample.

III. *Methods based upon the Reduction of Indigotin in an Alkaline Solution.*—It would answer no useful purpose in this paper if I were to give a detailed account of all the various methods which have been proposed for estimating indigotin by means of reducing agents. They have all one end in view—namely, the formation of indigo-white, by the action of nascent hydrogen, and its subsequent re-oxidation to indigotin. The separation of indigotin from the other matters present in indigo by processes of reduction, although a long and tedious operation, is generally considered to give accurate and reliable results. My experience has been, however, that this is not by any means always the case. Frizsche's method depends upon the reduction of indigotin in an alkaline alcoholic solution by means of grape sugar. The solution is then exposed to the air, when indigotin gradually separates out. Schunk has shown, however, that under certain conditions the whole or part of the indigotin may remain in solution combined with alcohol and acetic acid. Another plan is to treat finely-powdered indigo, out of contact with air, with a solution of ferrous sulphate and slaked lime. After gently heating the mixture for some hours the precipitated matters are allowed to subside; a measured volume of the clear liquid is decanted into a beaker, acidulated, and oxidised to indigotin. The precipitate is collected on a weighed filter, washed, dried, and weighed. The results obtained by this process are generally too low, as some of the indigotin is thrown down in the reducing flask with the mixed precipitate of iron oxides and lime.

* *Journal of the Society of Dyers and Colourists*, No. 4, Vol. I.
† An abstract from the *Journal of the American Chemical Society*.

TABLE II.

Showing the Percentage of Indigotin in Various Classes of Indigoes, by the Employment of Different Methods of Analysis.

Method.	I. Java.			II. Bengal *a*.			III. Bengal *b*.			IV. Oude.			V. Kurpah.			VI. Madras.		
	Highest.	Lowest.	Mean.*	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.
1. Permanganate (direct)	76·32	76·05	76·18	66·76	66·68	66·71	62·85	62·32	62·66	50·22	49·86	50·04	47·15	47·15	47·15	39·92	39·30	39·50
2. Permanganate (after precipitation by sodium chloride)	73·82	73·27	73·55	—	—	63·50	57·74	57·30	57·50	—	—	44·90	43·30	42·90	43·10	—	—	37·40
3. Hyposulphite (volumetric)	68·92	68·05	68·78	59·52	58·86	59·26	55·84	55·21	55·66	43·28	43·08	43·18	42·72	42·32	42·52	37·35	36·56	36·80
4. Sublimation	61·03	60·69	60·84	57·95	57·12	57·50	50·50	48·22	49·36	41·96	41·25	41·60	42·37	41·48	41·92	40·42	38·52	39·56
5. Reduction (by ferrous sulphate and sodium hydrate)	68·50	67·82	68·24	59·43	58·12	58·84	56·03	53·59	54·34	—	—	44·50	41·75	40·88	41·50	34·95	33·88	34·50
6. Reduction:—(hyposulphite and lime).																		
{Indigotin	69·25	68·65	68·97	59·35	58·89	59·12	56·64	55·92	56·20	43·65	42·99	43·42	42·79	42·15	42·68	35·42	34·98	35·21
{Indigo red	4·50	4·01	4·23	3·84	3·24	3·50	3·00	2·60	2·80	3·93	3·42	3·65	2·52	2·25	2·45	4·12	3·75	3·98
Percentage of water	—	—	2·99	5·28	5·15	5·22	6·25	6·10	6·17	—	—	7·50	—	—	8·05	5·80	5·62	5·71
" ash	—	—	1·99	—	—	3·91	—	—	4·86	—	—	8·21	25·85	25·62	25·72	33·75	33·50	33·62

* The mean results, in the majority of cases, were deduced from three or more estimations.

Reduction by Ferrous Sulphate and Sodium Hydrate.—This method, devised by Crace-Calvert, gives more reliable results than the preceding ones, but, as described on page 196 of Crace-Calvert's work on "Dyeing and Calico-Printing," it requires a very long time to complete the operation. I have adopted the following plan for carrying out this process. One grm. of finely-powdered indigo is placed in a flask, with 2 grms. of ferrous sulphate, 5 grms. sodium hydrate, and about a litre of water. The flask is closed by a cork with three perforations, in one of which is fixed a syphon for running off the reduced indigo; the other apertures are used for the entrance and exit of a current of hydrogen or coal-gas. The mixture is kept at a temperature a little below the boiling-point for one-and-a-half to two hours, when the source of heat is withdrawn, and the insoluble matters allowed to subside; 500 c.c. are syphoned off, and the rest of the liquid in the flask accurately measured. The reduced indigo is allowed to oxidise, which may be accelerated by drawing a current of air through the solution. If the liquid be now filtered, it would generally take at least a day to pass through the filter, and furthermore, the filtrate would contain in solution a certain quantity of indigotin. On the other hand, if an acid be added to the solution, a variable amount of indigo-brown—dissolved by the caustic soda—would be precipitated with the indigotin and indigo-red. But indigo-brown, as well as indigo-red, is soluble in alcohol, and this property may be advantageously utilised. When the measured volume of reduced indigo has become oxidised, an excess of hydrochloric acid is added, and the precipitate allowed to subside; the clear supernatant liquid is then carefully poured on to a weighed filter, and the residue washed two or three times by decantation with hot water. The residue is now boiled with alcohol, and before filtering the liquid is cooled somewhat, in order that any dissolved indigotin may be deposited. The whole is then transferred to the filter, washed with 80 per cent alcohol, dried at 100°, and weighed. The result is indigotin.

Reduction by Sodium Hyposulphite and Lime.—I have now to describe a method which I believe has not before been published. About three years ago I first attempted to estimate indigotin by means of an alkaline solution of sodium hyposulphite, but only within the last few months have I made the process a success. In point of accuracy it leaves nothidg to be desired, and as regards the time required for its manipulation, it can be performed much more quickly than any other process of reduction. One grm. of finely-powdered indigo is ground into a thin paste with water, and introduced into a flask with 500 to 600 c.c. of lime water. The flask is furnished with an india-rubber stopper, which has four perforations, in one of which is inserted a syphon closed by a pinch-cock, and in another is fixed a funnel provided with a stop-cock; the other two apertures serve for the entrance and exit of a current of coal-gas. The flask is connected with a supply of coal-gas, and the contents heated to about 80° C.; 100 to 150 c.c. of a solution of sodium hyposulphite are now introduced by means of the funnel, and the mixture, which in a few minutes takes a yellow tint, is kept near the boiling-point for half an hour. After allowing the insoluble matters in the flask to subside, 500 c.c. are syphoned off, and the remaining liquid accurately measured. The sodium hyposulphite used in these estimations was five times the strength of the solution which has been previously described.

The 500 c.c. are poured into a conical flask, and by means of an aspirator a current of air is drawn through the liquid for about twenty minutes. The excess of hyposulphite is thus oxidised to sulphite, and the indigo-white to indigo-blue. When hydrochloric acid is added to sodium hyposulphite a copious precipitate of sulphur occurs, but after oxidising the liquid by a current of air the solution remains perfectly clear on the addition of an acid. An excess of hydrochloric acid is therefore added in order to dissolve any carbonate of lime which the pre-

cipitate may contain. The precipitate is collected upon a weighed filter, thoroughly washed with hot water, dried at 100°, and weighed. The weight thus obtained is indigotin and indigo-red. If it is desirable to determine the amount of each of these constituents, the filter with its contents is placed in an extraction apparatus, and the indigo-red dissolved out by means of alcohol. I have found the best form of apparatus for this purpose to be that devised by Prof. Church for the extraction of oil from oil-cakes; it may be found fully described in "Church's Laboratory Guide."

Example IV.—One grm. of indigo was reduced by a mixture of sodium hyposulphite and lime-water. The liquid measured 935 c.c. 500 c.c. were oxidised, and treated as above described. Weight of precipitate = 0·243.

$$\therefore \frac{0{\cdot}243 \times 935 \times 100}{500 \times 1} = 45{\cdot}44 \text{ p.c. indigotin and indigo-red.}$$

The filter was placed in the extraction apparatus, and the red dissolved by means of alcohol. The alcoholic solution was evaporated to dryness, dried at 100°, and weighed. Weight of extract = 0·0145. From this amount 1 m.grm. was subtracted in order to allow for the slight solubility of indigotin in alcohol.

$$\therefore \frac{0{\cdot}0135 \times 100 \times 935}{500} = 2{\cdot}52 \text{ per cent indigo-red.}$$

Indigotin (by difference) = 42·92 per cent.

I have applied the principle of this method to a volumetric process, by means of which, in given samples of indigoes, concordant results have been obtained in less than half an hour. However, as the impurities of indigoes are somewhat affected by the reaction, I deem it advisable to make further experiments before publishing an account of the process.

Recapitulation.—The deductions which I have drawn from these estimations and experiments may be thus summarised:—

1. Indigo, when finely pulverised, is completely dissolved by ordinary concentrated sulphuric acid, at a temperature of 90° to 95° C., in the space of one hour.

2. The permanganate method affords a quick and ready means for the approximate valuation of indigoes, but as substances soluble in dilute acids are, at the same time, more or less acted upon, the results obtained are somewhat too high.

3. If the solution of indigo be saturated with sodium chloride, the colouring-matter is thereby precipitated. When the precipitate is washed, dissolved in dilute sulphuric acid, and titrated with potassium permanganate, results are obtained which, for all practical purposes, are trustworthy and reliable. Indigo-red and indigotin are simultaneously estimated by this modified process.

4. Of all the volumetric methods which have been devised for estimating *indigotin*, the sodium hyposulphite process is capable of giving at the same time the quickest and most accurate results; but, as has been previously stated, considerable care and delicacy are required in its manipulation.

If the solution of indigo to be titrated with hyposulphite contain iron in the ferric state, then the result obtained will be too high.

5. Other bodies than indigotin, which are present in indigoes, are more or less affected by the process of sublimation, whilst indigotin itself is partially decomposed into a dark brown substance, which does not volatilise without complete destruction. According to the quality of the indigo, the results obtained by this process may be either too high or too low.

6. The gravimetric reduction processes, as commonly described, are not quite so accurate as is generally supposed. Perfectly reliable and accurate results are, however, obtained by the use of sodium hyposulphite and lime-water. The reduction is complete in less than half an hour. Where an exact chemical analysis is required, this method, I consider, gives the best results of any process which has hitherto been published.

In conclusion, it gives me pleasure to acknowledge my obligations to Mr. Thornton, who has so cordially afforded me opportunities for carrying on the experiments and analyses connected with the preparation of this paper.

ANALYSES OF GRAPHITE FROM THE BAGOUTAL MOUNTAINS.

By WALTER HEPWORTH-COLLINS.

The four samples of graphite, the analyses of which are appended, are from the Bagoutal Mountains, Siberia.

This graphite is now being used, I am informed, for crucible making, with excellent results.

It seems to be generally of a similar character to that from the Stepanovsky mine (Sergius Kern, Chemical News, vol. xxxii., p. 229).

	Per cent.			
	No. 1.	No. 2.	No. 3.	No. 4.
Carbon	38·16	38·09	40·31	39·09
Silica	39·22	39·37	38·00	38·75
Alumina	14·20	13·91	13·21	14·04
Lime and magnesia	2·23	3·01	2·07	1·19
Ferric oxide	4·72	4·10	5·15	4·10
Vol. matt. and loss	1·47	1·52	1·26	2·83
	100·00	100·00	100·00	100·00

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IS THERE A CONSTANT RELATION BETWEEN THE HEATS OF FORMATION OF CHLORIDES AND SULPHATES IN AQUEOUS SOLUTION?*

By IRVING W. FAY.

The series of results obtained by Mr. Richards, as above described, suggested the inquiry whether a like constant relation might not be found between the heats of formation of the *chlorides* and *sulphates* in aqueous solution. Accordingly, a series of experiments was made involving this general reaction—

$$\tfrac{1}{n}R_m(SO_4)_n + BaCl_2.2H_2O.$$

All work was done in a constant-temperature room. The calorimeter was the one used by Mr. Richards, and the accessories were in every respect the same as those described by him.

The materials required were a standard solution of barium chloride, and a solution of each of the sulphates to be acted upon containing a sufficient excess to insure complete precipitation of the barium. Accordingly, a standard solution of barium chloride was made of the strength represented by the expression—

$$BaCl_2.2H_2O + 200H_2O.$$

From this standard value the required amount of each sulphate was easily calculated.

For every experiment 250 c.c. of the baric chloride and 250 c.c. of the sulphate solution were used. Hence this amount of water, increased by the water equivalent of the calorimeter, stirrer, and thermometer, gave the total water equivalent, which was exactly the same for each experiment.

The mode of experimenting was precisely like that in the paper by Mr. Theodore W. Richards (Chemical

* *Proceedings of the American Academy of Arts and Sciences.*

News, vol. lviii., p. 16), and the maximum rise of temperature took place in less than fifteen seconds, which rendered unnecessary any correction for cooling. The limit of error did not exceed 0·02° C., and if any accidental cause of uncertainty arose, a second experiment was made for confirmation.

The following example is taken at random from the note-book.

Temperature of $BaCl_2$ sol. in calorimeter ..	16·94°
,, ,, Na_2SO_4 sol. in beaker.. ..	16·78°
Mean	16·86°
Final observed temperature	17·50°
Rise of temperature	0·64°

The last column of the following table shows the amount of heat produced by the reaction of one molecule (244 grms.) of baric chloride upon one molecule of sulphuric acid in combination with a base, both being in aqueous solution. The next column to the left gives the observed rise of temperature; and, since the amount of baric chloride used was the same in every case, the values in either column may be directly compared with each other.

		°	C.
1.	$BaCl_2$ and Na_2SO_4	0·64	5171
2.	,, ,, Na_2SO_4	0·63	5089
3.	,, ,, K_2SO_4.	0·68	5594
4.	,, ,, $(NH_4)_2SO_4$.	0·70	5556
5.	,, ,, $MgSO_4$	0·70	5556
6.	,, ,, $ZnSO_4$.	0·70	5556
7.	,, ,, $CdSO_4$.	0·715	5776
8.	,, ,, $CuSO_4$.	0·685	5534
9.	,, ,, $NiSO_4$.	0·71	5736
10.	,, ,, $CoSO_4$.	0·71	5736
11.	,, ,, $FeSO_4$.	0·72	5817
12.	,, ,, $\frac{1}{3}Al_2(SO_4)_3$	0·805	6504
13.	,, ,, $\frac{1}{3}Al_2(SO_4)_3$	0·805	6504
14.	,, ,, $\frac{1}{3}Fe_2(SO_4)_3$	0·85	6864
15.	,, ,, $\frac{1}{3}Fe_2(SO_4)_3$	0·85	6864
16.	,, ,, $\frac{1}{4}K_2Al_2(SO_4)_4$	0·83	6704
17.	,, ,, $\frac{1}{4}K_2Al_2(SO_4)_4$	0·81	6544
18.	,, ,, $\frac{1}{4}K_2Cr_2(SO_4)_4$	0·80	6464
19.	,, ,, $\frac{1}{4}K_2Cr_2(SO_4)_4$	0 79	6184
20.	,, ,, $\frac{1}{4}(NH_4)_2Fe_2(SO_4)_4$ ..	1·02	8240
21.	,, ,, $\frac{1}{4}(NH_4)_2Fe_2(SO_4)_4$ ..	1·03	8320
22.	,, ,, H_2SO_4.	1·225	9904

The first noticeable fact observed in the above table is, that the difference between the heats of formation of chloride and *sulphate* is *not* the same for all metals, as it was found to be in the case of the chlorides and *nitrates*. It will be noticed, however, that with sulphates of allied bases the agreement is as close as before, but the sesquioxide salts give a larger amount of heat than the protoxide, and the double salts a still larger quantity, and sulphuric acid much the largest of all. It is a singular fact, that in the case of common alum the heat evolved is greater than it is with either of its constituent salts.

LEAD SLAGS.

By MALVERN W. ILES.

(Continued from p. 19).

Analytical Data.—In the table of slag analyses, the date indicates when the analysis was performed; in most cases the time of production and the date of analysis do not widely differ. The numbers simply serve to distinguish one kind of slag from another.

The fire assays were in every case carefully determined. The specific gravity determinations were in almost every case found by use of the Jolly spring balance. Some of the earlier determinations of silica are a trifle too high, but by far the largest number of tests were the result of careful fusion. Lately it has been found that accurate silica determinations could be obtained by taking the slag samples in a manner previously mentioned. The iron was determined by the use of a standard solution of potassium permanganate, with, except perhaps, those given by Mr. R. C. Ballard. The lime tests were made partly by gravimetric and partly by volumetric tests. Some of the manganese tests are by the well-known bromine method and weighed either as a phosphate or an oxide of manganese; all of the more recent determinations were made by using the excellent zinc oxide method, the details of which have been fully given under the heading of chemical analysis. The alumina, magnesia, and lead determinations were made by use of the good old fashioned methods. The sulphur test was performed by fusion with caustic potash as above indicated.

In the table of analyses there may be found every kind of type of slag produced in connection with the lead-silver smelting industry I have been able to find up to the time of writing (July, 1884). In several cases certain types have been repeated to show how the lead and silver losses vary under different circumstances, as for example when producing high or low grade bullion. The extreme limits of lead slags may be stated as follows:—

	Per cent.
SiO_2	26 to 41
Fe+Mn	18 to 35
CaO	5 to 35

It is exceedingly rare that the extremes will work satisfactorily for long campaigns; yet often to accomplish certain results, as for example freeing the crucible of the furnace from obstructions or crusts, one can very materially prolong the life or campaign of the furnace by the use of certain extreme slags. By very careful observation based upon analytical data the metallurgist can determine whether the trouble arising from the crucible be due to a siliceous accumulation, an iron crust, or a charcoal, coke, zinc, or lead crust; by acting upon any of these crusts at the right time and for a sufficiently long time with certain slags we can generally eliminate these troubles.

Most of the best slags will have a composition ranging somewhere within these limits:—

	Per cent.
SiO_2	31 to 36
Fe+Mn	23 to 30
CaO	14 to 25

And to still further restrict the limits, we may say that the best work is done, the campaigns are longest, and in the short the most economical slag produced, when its composition lies within these very narrow limits:—

	Per cent.
SiO_2	31 to 34
Fe+Mn	24 to 27
CaO	14 to 25

In some very exceptional cases, and on certain ores, it may be best to have a slag containing less than 31 per cent or more than 34 per cent silica; and the same may be said in regard to the iron, manganese, and lime bases. The prices paid for iron and iron fluxes, taken in connection with the impurities to be contended with, should in short determine the type of slag to be produced. To decide exactly what is the best slag for the treatment of ores where zinc, alumina, magnesia, baryta, and arsenic enter either singly, or all together, in large quantities, is necessarily a very intricate and difficult problem. For the reasons just cited no one slag can be said to be the best under all circumstances. A careful investigation of the analytical data as given in the table will, I think, present some very interesting features, and at the same time disclose some hitherto unrecorded facts.

Analyses of Argentiferous Lead Slags.

Date.	No.	Fire Assay. Ozs. Ag.	P.c. Pb.	Sp. gr.	SiO_2.	FeO.	Fe_2O_3.	=Fe.	CaO.	MnO.	Al_2O_3.	MgO.	PbO.	ZnO.	PbS.	S.	Total.	Analyst and Remarks.
April 27, 1880	1	2·00	3·00	—	28·10	43·92	4·33	—	5·60	5·58	1·85	3·54	5·23	—	—	0·98	99·13	M. W. Iles.
April 20, 1880	2	2·00	5·75	3·85	26·45	37·11	7·88	—	8·38	5·20	4·29	3·23	6·19	—	—	0·55	99·28	Do.
April 24, 1880	3	3·00	4·50	3·80	28·50	42·21	9·48	—	4·50	5·21	0·62	3·06	6·51	—	—	0·82	100·91	Do.
May 5, 1880	4	2·00	1·50	—	29·15	38·79	6·37	—	6·97	6 97	1·31	4·25	5·88	—	—	0·97	100·66	Do.
June 7, 1880	5	2·50	3·00	—	37·60	41·54	—	—	—	5·02	4·45	—	—	—	—	—	—	Do.
July, 1880	6	2·50	3·15	3·62	31·50	30·40	12·23	—	6·00	4·65	4·40	2·99	5·46	—	—	1·30	98·93	Do.
Jan. 15, 1880	7	1·00	1·25	3·57	30·20	36·19	—	—	22·80	3·81	4·29	0·14	2·36	—	—	0·62	100·41	Do.
	8	—	—	—	29·27	45·17	—	—	8·03	3·91	4·56	4·60	—	—	3·91	—	99·45	R. C. Ballard.
	9	—	—	—	31·32	39·16	—	—	8·52	7·96	5·79	7·79	—	—	2·50	—	103·04	Do.
	10	—	—	—	34·12	37·65	—	—	7·54	4·11	6·23	—	4·45	—	—	—	—	Do.
Oct. 7, 1880	11	Trace	1·00	—	33·50	49·88	—	—	—	—	—	—	—	—	—	—	—	M. W. Iles.
Jan. 17, 1881	12	1·00	1·50	3·56	39·10	39·09	—	(30·40)	8 30	5·02	0·85 (by diff.)	3·80	2·65	—	—	1·19	100·00	Do.
July 12, 1881	13	0·50	0·90	3·45	33·40	34·71	—	(26·99)	25·10	2·00	2·44	Trace	1·57	—	—	0·71	99·93	Samuel James.
	14	—	—	—	31·70	35·62	—	(27·70)	26·50	2·58	2·10	,,	Trace	—	—	0·88	99·38	Do.
	15	—	—	—	31·20	40·35	—	(31·38)	19·90	2·35	2·78	—	3·79	—	—	0·55	100·92	Do.
July 16, 1881	16	1·75	3·50	—	36·40	38·31	—	(29·80)	10·00	—	—	—	—	—	—	—	—	M. W. Iles.
July 27, 1881	17	1·75	2·25	—	35·80	41·65	—	(32·40)	12·40	3·35	2·13	Trace	3·24	—	—	0·86	99·43	Do.
July 30, 1881	18	1·25	2·00	—	40·20	33·43	—	(26·00)	16·60	3·54	2·86	,,	3·12	—	—	0·50	100·25	Do.
July 29, 1881	19	1·46	2·16	—	36·00	41·14	—	(32·00)	13·20	3·54	2·04 (by diff.)	—	3·23	—	—	0·85	100·00	Do.
Feb. 28, 1882	20	—	—	—	37·96	37·14	—	(30·00)	12·84	4·24	4·33	Trace	3·25	—	—	0·90	100·66	Do.
May 7, 1882	21	Trace	1·75	3·50	35·40	38·18	—	29·70	13·50	2·75	—	—	—	—	—	—	—	W. T. Page.
March 29, 1882	22	1·75	2·50	—	34·10	45·00	—	35·00	—	—	—	—	—	—	—	1·52	—	W. R. Boggs.
1879	23	1·79	1·60	3·48	34·79	37·69	—	29·32	13·68	3·87	—	—	—	—	—	—	—	W. R. Boggs. Av. of 15 samples.
	24	1·75	1·25	—	33·00	49·60	—	38·60	10·80	—	—	—	—	—	—	—	—	W. R. Boggs.
	25	5·00	6·50	—	29·00	43·00	—	—	—	—	—	—	—	—	—	—	—	Do.
	26	7·00	8·50	—	34·60	44·20	—	34·40	5·80	—	—	—	—	—	—	—	—	Do.
1880	27	12·00	1·75	3·75	25·80	43·80	—	—	10·10	—	—	—	—	—	—	—	—	Do.
August 30, 1882	28	1·50	3·00	3·65	33·80	47·30	—	—	12·80	1·60	—	—	—	—	—	1·84	—	Do.
Sep. 1, 1882	29	Trace	1·00	—	31·80	33·70	—	—	25·20	1·10	—	Trace	1·60	—	—	1·62	—	Do.
March 21, 1833	30	0·90	1·80	3·60	33·50	37·90	—	—	17·05	—	—	—	—	—	—	—	—	W. T. Page.
	31	3·80	2·10	3·47	33·25	31·90	—	—	19·40	—	—	—	—	—	—	—	—	Do.
1883	32	0·75	1·25	—	35·95	24·40	—	—	25·05	4·75	—	Trace	—	0·30	—	2·67	—	Do.
March 21, 1883	33	5·10	3·10	3·78	32·00	42·70	—	—	14·20	—	—	—	—	—	—	—	—	Do.
May 23, 1883	34	0·25	1·30	3·75	30·00	43·20	—	—	13·30	4·55	—	—	—	—	—	—	—	Do.
June 14, 1883	35	3·10	10·00	—	28·00	30·94	—	—	16·20	—	—	—	—	—	—	—	—	W. T. Page. Charge incorrectly calc. Mn very large; not determined.
June 20, 1883	36	0·90	2·00	—	35·40	20·36	—	—	14·80	14·83	—	—	—	—	—	—	—	W. T. Page.
	37	1·25	1·25	—	34·co	23·04	—	—	14·80	12·70	—	—	—	—	—	—	—	Do.
Jan., Feb., 1884	38	0·95	1·41	—	36·76	34·45	—	—	16·61	5·38	—	—	—	—	—	—	—	W. T. Page. Av. of 8 analyses; two months' run.
1879	39	3·00	3·00	—	31·00	41·52	—	—	15·00	1·93	—	—	—	—	—	—	—	W. T. Page. Abandoned dump.
	40	3·00	3·70	—	38·40	40·62	—	—	7·00	7·48	—	—	—	—	—	—	—	Do.

(To be continued).

Chemical News, Jan. 27, 1888.

ON MEASURING LIQUIDS BY DROPS.

By A. F. REID.

The size of drops depends upon the form of the surface from which they hang. The following experiments were made with a hundred grain pipette. The number of drops in burettes vary with the position of the stopcock. A pipette was therefore preferred.

1. The number of drops increases with the time taken, thus :—

Water at 2° C., about ½ drop per second ..	141 drops.
,, ,, 2 or 3 drops ,, ..	136 ,,

2. The number of drops increases with the temperature. For example :—

Water at 170° F. (77° C.), 2 or 3 drops per sec.	156 drops.
,, 160° F. (71° C.), ,, ,, ,,	155 ,,
,, 150° F. (65° C.), ,, ,, ,,	154 ,,
,, 140° F. (60° C.), ,, ,, ,,	153 ,,
,, 130° F. (54° C.), ,, ,, ,,	152 ,,
,, 120° F. (49° C.), ,, ,, ,,	151 ,,
,, 110° F. (43° C.), ,, ,, ,,	150 ,,
,, 100° F. (38° C.), ,, ,, ,,	148 ,,
,, 90° F. (32° C.), ,, ,, ,,	147 ,,
,, 80° F. (27° C.), ,, ,, ,,	145 ,,
,, 70° F. (21° C.), ,, ,, ,,	143 ,,
,, 60° F. (15·5° C.), ,, ,, ,,	141 ,,
,, 50° F. (10° C.), ,, ,, ,,	139 ,,
,, 40° F. (4° C.), ,, ,, ,,	137 ,,
,, 32° F. (0° C.), ,, ,, ,,	135 ,,

Near the freezing-point every 10° F. is increased by two drops, at higher temperatures by one drop. The number of drops decreases rather more rapidly near the freezing-point.

3. The number of drops is increased when a substance is in solution :—

Saturated solution of ammonium oxalate at 4° C., 2 or 3 drops per second.. ..	139 drops.
Saturated solution of sodium phosphate at 4° C., 2 or 3 drops per second.. ..	138 drops.

The following are some other liquids at 12° C. at the rate of about two drops per second :—

Absolute alcohol	387 drops
Ether	452 ,,
Carbon disulphide	428 ,,
Sulphuric acid	340 ,,
Hydrochloric acid	182 ,,

This method may be used in determining the relative quantities of alcohol and water in mixtures of these liquids.

Bonshaw, Stewarton, N.B.,
December 30, 1887.

LONDON WATER SUPPLY.

Report on the Composition and Quality of Daily Samples of the Water Supplied to London for the Month ending December 31st, 1887.

By WILLIAM CROOKES, F.R.S.;

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To General A. De Courcy Scott, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, January 7th, 1888.

Sir,—We submit herewith the results of our analyses of the 182 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from December 1st to December 31st inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

The whole of the 182 samples examined were clear, bright, and well filtered.

The uniformly excellent character of the water supplied to the Metropolis for a long while past has been satisfactorily maintained during the month of December. In respect to its degree of freedom from tint of colour and excess of organic matter, the numerical results obtained were found to differ but little from those taken note of for some time back. The mean proportion of organic carbon in the Thames-derived supplies, or 0·160 part, and the maximum proportion in any sample, or 0·188 part in 100,000 parts of the water, although indeed slightly in excess of the respective means and maximums of previous months, are quite exceptionally low for the period of the year, as are also the numbers expressing the degree of freedom of the water from colour tint. The mean proportion of organic carbon for the last six months of the year, or 0·143 part in 100,000 parts of the water, corresponds, as nearly as may be, to one-quarter of a grain of organic matter per gallon.

We are, Sir,
Your obedient Servants,
William Crookes.
William Odling.
C. Meymott Tidy.

NOTICES OF BOOKS.

Year-Book of Pharmacy: comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, contributed to British and Foreign Journals from July 1st, 1886, to June 30th, 1887, with the Transactions of the British Pharmaceutical Conference at the Twenty-fourth Annual Meeting, held at Manchester, August, 1887. London: J. and A. Churchill.

This volume contains, as usual, an abundance of interesting matter, much of which, however, has already appeared in various journals. We note with interest the abstract from the *Journal of Physiology* of a paper by Mr. R. N. Wolfenden, in which it is shown that the deadly property of the venom of the cobra is not due to a micro-organism, or ptomaine, or any alkaloid, nor yet to the cobric acid of Blyth, which is pronounced to be merely calcium sulphate. The poisonous ingredients belong to the proteine group, and consist of globuline, syntonine, and serum-albumen.

It is not generally known that the inner bark of the white flowering acacia is decidedly poisonous. At Brooklyn thirty-two boys, who had met with a quantity of the bark, were rendered dangerously ill by chewing it.

The entire section on Materia Medica and Pharmacy is well compiled, and no longer contains any matter which might be preferably classed under Chemistry.

Under Notes and Formulæ we find cantharides, applied to the wound and taken internally, recommended for the prevention of hydrophobia, and cocaine applied to the back part of the throat suggested as a remedy for the disease when it has actually set in.

The dried leaves of the castor-oil plant, in powder, and a decoction of the fresh leaves are recommended for banishing flies and other troublesome insects.

In glancing over the valuable chemical and pharmaceutical bibliography of the year we notice that certain authors, who are Fellows both of the Chemical Society and of the Institute of Chemistry, place after their names the initials F.I.C. *before* F.C.S. Surely the Chemical Society, both in alphabetical order and as the senior society, is entitled to precedence.

The Presidential Address at the Conference, delivered by Mr. S. R. Atkins, contains not a few suggestive passages. Among the conditions required for research, as distinguished from invention and application, he enumerates "an industry bordering on enthusiasm, an indifference to vulgar unreflecting applause, the absence of lionising and public dinners, and the non-necessity of a mill-horse round of teaching others." To such conditions the spirit of the age is, he admits, not helpful to research. Again, "The restlessness of the age is alien to research."

We are glad to find that the Pharmaceutical Conference has begun to award sums of money for assistance in conducting specified lines of research.

The Retrospect of Medicine: being a Half-yearly Journal containing a very Retrospective View of every Discovery and Practical Improvement in the Medical Sciences. Edited by James Braithwaite, M.D Vol. XCVI., July to December, 1887. London Simpkin and Marshall.

This volume contains less matter of a character interesting outside of the medical profession than is usually the case.

There is a notice of the newly-discovered poison in milk which has been described, by Dr. V. C. Vaughan, under the name of tyrotoxicon. This poison, doubtless a ptomaine, is chemically speaking diazo-benzol. It is developed in milk by the growth of a micro-organism which multiplies rapidly under favourable conditions. These are principally the exclusion of air, entirely or to a great extent, and a temperature approaching 36°. It is observed that these conditions occur if milk, as it is drawn from the udder of the cow, is placed in cans and tightly closed.

The British Journal Photographic Almanac and Photographer's Daily Companion for 1888. A Complete Compendium of Photographic Art Science. Edited by J. Traill Taylor. London: H. Greenwood and Co.

The multitude of persons who practise photography, whether professionally, for amusement, or as a powerful auxiliary in scientific research, fully warrants the appearance of a special almanac of goodly dimensions. The almanac department, in the strict sense of the word, contains in each month the anniversaries of important steps taken in the art, and, on the opposite page, the meetings of photographic societies.

Then follow, in alphabetical order, notices of the photographic societies of the United Kingdom, the Colonies, America, and the Continent.

Next we find papers on a variety of subjects pertaining to the art. Among these we particularly notice a memoir by Captain Abney, on the "Monochromatic Illumination of Microscopic Objects," and one by Dr. Maddox, on "Small *v.* Large Negatives for Photo-micrographs."

In an essay by Mr. H. P. Robinson, on "Figure, Landscape, and Combination-printing," we regret to find the word "phenomenal" used in its utterly illegitimate sense of "remarkable" or "unusual."

Mr. J. J. Bigginshaw contributes a useful paper entitled "Aids to Photo-microscopy."

After these miscellaneous papers follow "Technical Essays for Young Photographers," in twelve chapters, by the Editor, and an "Epitome of Progress during 1887."

A variety of receipts and formulæ, tables, &c., complete this very useful work.

Report of the Commission of Internal Revenue for the Fiscal Year ending June 30th, 1887. Washington: Government Printing Office.

The contents of this Report scarcely come within our cognizance, being of a kind more calculated to interest economists and statisticians.

Oleomargarine is discussed to some extent, and we learn incidentally that such misleading names as "butterine" are being prohibited in most countries. The analytical methods used in case of suspected samples are those of Hehner and Angell for the estimation of insoluble fatty acids, and that of Reichert for the soluble and volatile fats. It is pointed out that oleomargarine and artificial butters generally are found to be not more, but *less*, liable to rancidity than genuine butter, in consequence of the very small proportion of soluble and volatile butter-acids which they contain. The difference in digestibility between genuine and artificial butters is nearly inappreciable.

CORRESPONDENCE.

A NEW DEPARTURE IN BRAZING AND WELDING.

To the Editor of the Chemical News.

Sir,—The cheapening of oxygen by Brin's process of manufacture has put into the hands of metal workers a new power. I have recently made a few experiments with the compressed oxygen and coal gas, and found that with a ½-inch gas supply a joint could be brazed in a 2-inch wrought-iron pipe in about one minute, the heat being very short, the redness not extending over 1 inch on each side of the joint.

The appearance of the surface after brazing led me to to experiment further with welding, a process which is not possible with ordinary coal gas and air, owing to the formation of magnetic oxide on the surfaces. Contrary to my expectation a good weld was obtained on an iron wire ⅛ inch in diameter, with a very small blowpipe, having an air jet about $\frac{1}{32}$ inch diameter. This matter requires to be taken up and tried on a large scale for such work as welding boiler-plates, which, it appears to me, can be done perfectly with far less trouble than would be required to braze an ordinary joint. The great advantage of this would be that the boilers would require no handling, but could be welded with an ordinary large blowpipe in position, and with about one-tenth the labour at present necessary.

The cost of the oxygen is trifling, and it is evident, from the results obtained in brazing, that the consumption of gas would be considerably less than one-fourth that necessary with an air-blast, irrespective of the fact that welding is possible with an oxygen-blast, whereas it is not possible if air is used.

The surface of iron heated to welding heat by this means comes out singularly clean and free from scale, and a small bottle of compressed oxygen, with a blowpipe and a moderate gas supply, would make the repairs of machinery, boilers, brewing coppers, and other unwieldy apparatus, a very simple matter. The trouble and difficulty of making good boiler crowns, which so frequently "come down," would be very small indeed when the workmen has an unlimited source of heat at command, under perfect and instant control.—I am, &c.,

Thos. Fletcher.

Warrington, January 17, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cv., No. 26, December 26, 1887.

This issue contains merely a notice of the awards of the prizes the bestowal of which is in the hands of the Academy of Sciences, and the announcement of the prizes proposed for the new year.

Moniteur Scientifique, Quesneville.
Series 4, Vol. i., September, 1887.

Patents taken out in Berlin relating to Colouring-Matters. — These include : — Improvements in the preparation of the mixed azo-colours obtained with benzidine or toluidine and β-naphthylamine-disulphonic acid (A, No. 1646).

Preparation of an α-α-naphthol-monosulphonic acid, of α-α-dioxy-naphthaline and its mono- or disulphonic acids (E, No. 1897).

Preparation of azo-colours by the reaction of the chlorides of tetrazo-diphenyl and tetrazo-ditolyl upon the aromatic meta-diamines and their sulpho-conjugated acids (O, No. 881).

Improvement in the preparation of the colouring-matters patented in Nos. 28,753 and 35,615 (A, No. 1636).

Use of double fluorides of antimony and of the alkaline metals as mordants in dyeing and printing (K, No. 5357).

Preparation of thio-resorcine (E, No. 1921).

Method of preparing alkylic β-naphthylamine-sulphonic acids (F. No. 3059).

Preparation of azo-colours dyeing claret or black-blue shades on wool by means of alkylic naphthylamine-sulphonic acids (F, No. 3113).

Violet tetrazo-colours derived from para-phenylene-diamine (B, No. 7613).

Preparation of alkylic indamines, indo-phenols, new-blue or naphthol-blue (F, No. 3118).

Vol. i., Part 2, October, 1887.

The Production of Chlorine in the Preparation of Oxygen from Potassium Chlorate.—F. Bellamy.—The author examines the manner of action of manganese di-oxide, copper oxide, &c., in facilitating the liberation of oxygen from potassium chlorate by heat. He considers that these substances act by alternate super-oxidation and reduction, and that they act like acids. During these reactions compounds of chlorine are formed even if no impurities are present. When working with ordinary chlorate alone chlorine was found among the gaseous products in thirteen cases out of fourteen. The quantities are very variable. When manganese is used along with the chlorate large quantities evolve more chlorine than small ones. The author concludes that whatever substance is used to facilitate the decomposition of the chlorate, chlorine gas is evolved, especially at the beginning of the operation.

New or Improved Methods for Determining Organic Bodies by Means of Oxidation with Potassium Permanganate.—J. H. Smith.—From the *Journal of the Society of Chemical Industry.*

Notes on a Recent Visit to the Oil Regions of the United States and Canada. — Boverton Redwood. —From the *Journal of the Society of Chemical Industry.*

Contribution to the Study of Rotatory Polarisation in Parallel Light.—Dr. G. Quesneville.—This memoir does not admit of useful abstraction.

Researches on Gold.—Gerhard Krüss.—From *Liebig's Annalen.* The most important portions of this memoir have already appeared in the CHEMICAL NEWS.

The Alkaloids of the Coca Leaf.—O. Hesse.—From the *Pharmaceutical Journal.*.

Industrial Review and Various Patents.—Abstracts of specifications, chiefly German.

Patents on Colouring-Matters taken out at Berlin. —These include :—Improvement in the preparation of β-naphthylamine-δ-monosulphonic acid. F. Bayer and Co., of Eberfeld. F, No. 3055.

Preparation of ethers of meta-diamido-diphenic acid. Dr. L. Paul. P, No. 3099.

Preparation of benzyl acetate and ethylene diacetate. E. Seligin. S, No. 3620.

Soluble combinations of naphthazarine and of sulphites ; dyeing blacks or greys with this compound, or with naphthazarine. Baden Aniline and Soda Works. B, 4579.

Preparation of oxypyrazol by the action of the amides of acetyl-acetic ether, simple or substituted, upon phenyl-hydrazine. Meister, Lucius, and Bruning. F, No. 3140.

Improvements in the preparation of azo-colours obtained by the reaction of the chlorides of tetrazo-diphenyl or tetrazo-ditolyl upon the aromatic meta-diamines. K. Oehler. O, No. 904.

A colour for dyeing textile fibres. T. Maxwell and J Young. M, 4961.

Preparation of tetra-hydro-para-oxyquinoleine and its conversion into thalline. Baden Aniline and Soda Works. B, No. 7470.

Conversion of certain colouring-matters obtained according to Patent 38,735 into colours not sensitive to the action of alkalies. A. Leonhardt. L, No. 4003.

Preparation of a dioxy-naphthaline-monosulphonic acid. Berlin Joint Stock Aniline Co. A, No. 1501.

Yellow, brown, or red-brown azo-colours obtained with the dioxy-naphthaline-monosulphonic acid of the foregoing Patent. Berlin Joint Stock Aniline Co. A. 417.

Improved preparation of β-naphthylamine-δ-monosulphonic acid. Fr. Bayer and Co. F, No. 3077.

Further improvement in the preparation of β-naphthylamine-δ-monosulphonic acid. F. Bayer. F, No. 3104.

Colouring-matters prepared with tetrazo-dibenzol-diphenyl or its homologues, and resorcine, orcine, and naphthionic acid. E. Kegel. K, No. 5410.

Blue colouring-matters prepared with tetrazo-diphenol-ether. F. Bayer. F, No. 3216.

Purification of crude anthracene. C, No. 2258.

Preparation of dialkylic amido-benzophenones. Meister, Lucius, and Bruning. F, No. 3186.

M. Chevreul entering into his 102nd Year.—The congratulatory address of the Royal Academy of Sciences of Prussia.

Inauguration of the Statue of Nicolas Leblanc.—A discourse delivered by M. E. Peligot.

Experimental Solicitation of Emotive Phenomena in Subjects in a Hypnotised State.—J. Luys.—This memoir has no relation to chemistry.

Contribution to a Knowledge of Antimony Perchloride.—R. Anschütz and N. Evans.—A paper read before the Royal Society.

On Metallic Manganese.—Th. Bruce Warren.—From the CHEMICAL NEWS.

MISCELLANEOUS.

Explosives Act, 1875.—Colonel Majendie has forwarded to us the following copy of circular letter which he has addressed to the principal manufacturers and users of picric acid in the United Kingdom :—

"HOME OFFICE, 18th January, 1888.

"I have the honour to forward, for your information and guidance, two copies of an Order in Council which was made on the 29th December, 1887, and has since been duly published in the *London Gazette.*

"The effect of this Order is substantially as follows:—

"Whereas picric acid, picrates, and mixtures or combinations of picric acid with certain other substances, have hitherto ranked as "explosive" (within the meaning of the Explosives Act, 1875) *only* when "manufactured or used with a view to producing a practical effect by explosion or a pyrotechnic effect," in future—

"(1) Picric acid when in *process of manufacture or storage* (for whatever purpose used or manufactured) will rank as an explosive except when certain conditions, (*a*) and (*b*), as set forth in the Order are complied with; and—

"(2) Picrates and mixtures of picric acid with substances capable of forming an explosive mixture or an explosive compound (for whatever purpose used or manufactured) will rank as explosives for all the purposes of the Act (and not merely when in process of manufacture or stowage), except when wholly in solution.

"Accordingly, if you are unable to satisfy the exempting conditions set forth under (1) and (2) above, you should take steps to ascertain the requirement of the Act affecting nitro-compounds, and to conform to the same as far as they may be applicable to your business."

The following are the conditions (*a*) and (*b*) referred to in the above letter:—

(*a*) Picric acid when wholly in solution shall be exempt from being deemed to be an explosive within the said Act; and—

(*b*) Picric acid which does not fall within the exemption (*a*) above set forth, but which is being manufactured or stored in a factory, building, or place exclusively appropriated to the manufacture or storage of picric acid, and in such manner as effectually to prevent any picric acid from coming into contact (whether under the action of fire, or otherwise) with any basic metallic oxide or oxidising agent, or other substance capable of forming with picric acid an explosive mixture or explosive compound, or with any detonator or other article capable of exploding picric acid, or with any fire or light capable of igniting picric acid, shall be exempt from being deemed to be an explosive within the said Act.

NOTES AND QUERIES.

Magnetic Carbide of Iron.—Can any reader supply information respecting the process of manufacturing magnetic carbide of iron, used, I believe, sometimes for filtration?—JUNIOR.

MEETINGS FOR THE WEEK.

MONDAY 30th.—Medical, 8.30.
—— Society of Arts, 8. "Yeast, its Morphology and Culture," by A. Gordon Salamon, F.C.S.
TUESDAY, 31st.—Institution of Civil Engineers, 8.
—— Society of Arts, 8. "Monumental Use of Bronze," by J. Starkie Gardner, F.G.S.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
WEDNESDAY, Feb. 1st.—Society of Arts, 8. "The Sweating System, or the Functions of the Middleman in relation to Labour," by D. F. Schloss.
THURSDAY, 2nd.—Royal, 4.30.
—— Royal Institution 3. "Art Education," by Hubert Herkomer, M.A., A.R.A.
—— Chemical, 8. Ballot for the Election of Fellows. Lecture on "The Range of Molecular Forces," by Prof. A. W. Rücker, F.R.S.
—— Parkes Museum, 5. "The History and Present Position of the Germ Theory of Disease," by Prof. E. M. Crookshank, M.B.
FRIDAY, 3rd.—Geologists' Association, 8. (Anniversary).
—— Royal Institution, 9. "Ancient Microscopes," by Frank Crisp, LL.B., &c.
SATURDAY, 4th.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.

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The Gas Committee of the Corporation of BIRMINGHAM are prepared to receive Tenders for the Tar to be produced at their various Works from the 30th of June next, for a period of one or two years, or for one year and then subject to termination of the contract on three months' notice on either side.
The quantities to be dealt with in the year ending 30th June, 1889, are estimated as follows:—
Saltby Works, 9000 tons.
Windsor St. Works, 7300 tons.
Adderley St. Works, 2400 tons.
Swan Village Works, 2550 tons.
The Committee will receive Tenders either at a fixed price per ton or at a varying price to be calculated on the actual returns obtained from time to time on the sale of the products derived from the Tar, provided that in such case the Contractor is dealing only with the Corporation Tar.
The Corporation will be willing to let on lease Land on which Tar Works could be erected, or they would erect Works on their own land and let them to the Contractor.
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EDWIN SMITH, Secretary.
Borough Gas Office, Council House,
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THE CHEMICAL NEWS.

Vol. LVII. No. 1471.

-6 FEB 88

THE ACTION OF SULPHUR AND SULPHUR CHLORIDE ON OILS.

By THOMAS T. P. BRUCE WARREN.

The adulteration of lard and lard oil with cotton-seed oil, &c., can easily be detected by sulphur chloride. The separation of certain vegetable oils from animal oils and fats has been suggested by Parkes's Patent and disclaimer referred to in Chemical News (vol. lvii., p. 26).

As regards adulterated lard it is satisfactory to find that the Americans have made up their minds to deal boldly with this fraud. As we followed the Americans in framing the Margarine Act, we shall probably have some new legislation dealing with adulterated lard: that this fraud should be tolerated in the face of the "Food and Drugs Act, 1875," passes my comprehension.

American lard has been largely imported into this country, and a very great deal has been actually manufactured in this country in the same way. The injurious effect which this bogus lard has had upon our agricultural industry is too obvious to need comment. The injury to the lard-oil trade will be complete when users of this oil for lubricating know that the adulterated article can be put together for about one-half the price now paid for lard oil.

It cannot be urged that these frauds have just been exposed. If those interested in this subject will refer to the Chemical News (vol. lv., p. 134) they will find the statement that a firm in Chicago used one-fifth of the entire produce of cotton-seed oil in packing their lard, and that American lard is largely adulterated with cotton-seed oil. In vol. lvi., p. 133, we note that "sesame oil would be a good substitute for lard or butter."

Cotton-seed oil is used in vegetarian cookery; it is perfectly wholesome, and no one wishes to say anything against it on this point. But when it is used as a means for passing off the harder fats of beef or mutton as lard made from the fat of the pig, we are quite justified in regarding the matter with indignation.

The *Standard* (January 25th) gives some startling figures on this subject. About 50 million pounds of cotton oil are annually used in America in lard factories.

Sulphur chloride reveals this fraud without any difficulty. The melting-point of the fat, after removal of the oil, will enable one to say whether the pig has been requisitioned for fat in compounding this lard. The melting-point of the mixture is of no value as a test in this case.

It is not very flattering to our chemical reputation to wait until a foreign power finds the extent of a fraud becoming so formidable that it is necessary to deal with it so harshly as the Bill proposed by Senator Dawes proposes. In 1886-7 more than 100 million pounds of lard were produced over that of any previous year.

Adulteration is now carried out with *quasi*-scientific perfection; it is a mistake to rest upon a method of detection which is generally known, because anyone with a qualmish notion of honesty will not rest until he can circumvent the method. We do not find many cases of "bungling" fraud: on this account we must be prepared to deal not only with recognised systems of adulteration, but with any possible admixture which may be feasible.

The Antwerp Board of Trade have recently forwarded some strong representations to New York respecting this fraud, which will probably result in excluding from Belgium the import of this lard.

LEAD SLAGS.

By MALVERN W. ILES.

(Continued from p. 38).

Types.—By the term "slag types" are meant those slags which are built up according to some well-defined composition, and which always have a distinct crystalline form. Many of these types approach in composition certain well-known siliceous minerals. It is somewhat rare to find in the same piece or pot of slag more than a single kind or type, though such cases will occur occasionally when there is a marked change in the ore charge, or where there is fed into the furnace a slag different in composition from that produced by the ore and lime flux. I have studied slags, with no small amount of care and attention, through the following wide ranges of composition:—

	Per cent.
SiO_2	26 to 41
Fe	18 to 45
CaO	5 to 35
Mn	Trace to 40
MgO	Trace to 8

While it is possible, and even probable, that there may be some particular kind or class of slags which has escaped observation, the following types will include practically every known slag which is well adapted for argentiferous lead smelting:—

Types of Lead Slags.

Type.	Percentage.		
	CaO.	FeO+MnO.	SiO_2.
A	6	52	32
B	10	45	35
C	12	50	28
D	16	34	34
E	20	40	30
F	24	33	33
G	28	27	35

It must not be understood that these types are rigidly fixed, since all of them are subject to certain ranges or limits, and still may be quite fair slags. Some, it has been noticed, are subject to wider limits than others; this is particularly true of the type F. By observation and long experience it has been found that slags of a certain kind are easily fusible, run freely, prevent certain mechanical difficulties in the crucible, and admit of long campaigns. These slags occasion small silver and lead losses, and are therefore to be imitated as nearly as practicable; but to say that a certain slag is good or bad if the type is not accurately obtained is certainly erroneous. Where the type is so clearly approached that there occur certain slight alterations in the crystalline form, the slag may be, and generally is, a very good one to make; now to alter the slag so that the type may be more closely approached will sometimes be highly impolitic from a commercial standpoint. If, in short, we alter a slag which already closely approaches a given type, the cost should be an important item in the consideration, and not the beauty of the crystals.

I have noticed that most slags produced *between* certain recognised types assume a distinct appearance which more or less resembles that of the minerals pectolite and wavellite. Slags having a structure closely resembling these minerals may be designated as pectolitic or wavellitic slags. From what has been said it will be seen that all pectolitic and wavellitic slags may be regarded as abnormal. Generally pectolitic and wavellitic slags run high,—that is to say, carry too much lead and silver, especially the latter,—yet a very few exceptions to this statement have been noted where manganese enters largely into the composition.

There are a few well-defined crystalline slags which

ANALYSES OF ARGENTIFEROUS LEAD SLAGS (*continued*).

Date.	No.	Fire Assay. Ozs. Ag.	Fire Assay. P.c. Pb.	Sp. gr.	SiO_2.	FeO.	Fe_2O_3.	=Fe.	CaO.	MnO.	Al_2O_3.	MgO.	PbO.	ZnO.	PbS.	S.	Total.	Analyst and Remarks.
Feb. 24, 1884	41	1·00	1·50	—	32·50	36 90	—	—	19·00	3·87	—	—	—	—	—	—	—	W. T. Page.
Dec. 27, 1882	42	1·00	1·75	—	37·40	35·22	—	—	14·90	—	—	—	—	—	—	—	—	Do.
Feb. 1, 1883	43	Trace	1·50	—	38·40	33 90	—	—	13·20	—	—	—	—	—	—	—	—	Do.
March 14, 1883	44	1·25	1·25	—	31·50	28·00	—	—	18·90	—	—	—	—	—	—	—	—	Do.
May 2, 1883	45	1·00	0·50	—	31·50	27·50	—	—	20·10	—	—	—	—	—	—	—	—	Do.
May 3, 1883	46	0·50	0·50	—	32·75	26·50	—	—	20·30	—	—	—	—	—	—	—	—	Do.
Jan. 18, 1883	47	Trace	0·40	—	35·00	36·00	—	—	14·00	—	—	—	—	—	—	—	—	Do.
Feb. 23, 1884	48	1·25	0·50	—	31 75	31·37	—	—	16·40	—	—	—	—	4·53	—	—	—	Do.
	49	0·50	1·00	—	33·00	14·22	—	—	13·10	25·78	4·20	1·00	—	—	—	—	91·30	Do.
	50	Trace	1·40	—	29·60	11·56	—	—	7·50	43·25	6·34	Trace	—	—	—	—	98·25	Do.
Feb. 23, 1884	51	0·80	0·50	—	35·75	31·24	—	—	16·20	—	—	—	—	—	—	—	—	Do.
March 5, 1884	52	1·60	0·80	—	36·25	31·10	—	—	17·90	3·61	—	—	—	—	—	—	—	Do.
Oct. 2, 1882	53	0·05	0·90	—	33·50	31·90	—	—	17·90	—	—	—	—	—	—	—	—	Do.
March 13, 1884	54	Trace	0·70	—	33·80	34·20	—	—	19·25	3·47	—	—	—	—	—	—	—	Do.
March 17, 1884	55	1·20	0·70	—	33·80	30·20	—	—	20·75	4·14	—	—	—	—	—	—	—	Do.
March 19, 1884	56	1·90	0·70	—	34·00	29·96	—	—	20·80	3·99	—	—	—	—	—	—	—	Do.
March 21, 1884	57	1·50	0·70	—	34·40	29·83	—	—	19 80	3·89	—	—	—	—	—	—	—	Do.
March 24, 1884	58	1·20	0·50	—	34·25	32·80	—	—	17·10	3·45	—	—	—	—	—	—	—	Do.
April 3, 1884	59	1·70	1·10	—	33·85	29·90	—	—	19·90	3·51	—	—	—	—	—	—	—	Do.
April 7, 1884	60	1·30	0·50	—	33·20	30·34	—	—	20·60	3·50	—	—	—	—	—	—	—	Do.
April 9, 1884	61	0·80	0·70	—	33·10	30·09	—	—	19·80	4·75	—	—	—	—	—	—	—	Do.
April 11, 1884	62	1·10	0·50	—	31·85	32·98	—	—	20·05	4·54	—	—	—	—	—	—	—	Do.
April 14, 1884	63	1·05	0·40	—	31·95	30·90	—	—	22·75	3·22	—	—	—	—	—	—	—	W. T. Page. 135-oz. bullion.
April 15, 1884	64	0·45	0·50	—	33·00	28·93	—	—	23·65	3·42	—	—	—	—	—	—	—	W. T. Page. 138 oz. bullion.
April 18, 1884	65	0·50	0·70	—	32·90	29·11	—	—	22·00	2·86	—	—	—	—	—	—	—	W. T. Page. 160-oz. bullion.
April 22, 1884	66	0·60	0·50	—	33 00	26·89	—	—	23·95	3·00	—	—	—	—	—	—	—	W. T. Page.
April 28, 1884	67	1·40	0·60	—	33·20	27·51	—	—	24·00	—	—	—	—	—	—	—	—	Do.
March 5, 1884	68	0·50	0·60	—	34·60	30·09	—	—	22·00	2·97	—	—	—	—	—	—	—	Do.
	69	—	—	—	36·00	32·00	—	—	25·60	—	—	—	—	—	—	—	—	H. T. V. Furman. Pectolitic, fibrous.
	70	—	—	—	32 00	36·47	—	—	24·23	—	—	—	—	—	—	—	—	H. T. V. Furman. Fine translucent crystals.
	71	—	—	—	27 60	45·00	—	—	20·64	—	—	—	—	—	—	—	—	H. T. V. Furman. No lead found.
	72	—	—	—	29·80	39·50	—	—	19·30	—	—	—	—	—	—	—	—	H. T. V. Furman. "Old German slag."
	73	—	—	—	31·00	34·83	—	—	24·10	—	—	—	—	—	—	—	—	H. T. V. Furman. Tetragonal crystals.
	74	—	—	—	32·20	28·50	—	—	27·50	—	—	—	—	—	—	—	—	H. T. V. Furman. Almost cubes.
	75	—	—	—	25·50	40·97	—	—	16·00	—	—	—	2·70	7·62	—	—	—	H. T. V. Furman. Aluminous.
	76	—	—	—	35·80	25·50	—	—	29·50	0·60	3·90	—	1·36	—	—	—	—	H. T. V. Furman. Ran free.
	77	—	—	—	37·60	20·07	—	—	29·23	0·41	5·50	—	4·68	—	—	—	—	H. T. V. Furman.
	78	—	—	—	36·20	26·20	—	—	30·00	—	—	—	—	—	—	—	—	Do.
	79	—	—	—	32·20	27·70	—	—	25·20	—	—	—	—	6·05	—	—	—	Do.
	80	—	—	—	35·80	23·74	—	—	28·20	—	6·65	—	—	—	—	—	—	Do.
	81	—	—	—	39·00	22·30	—	—	29·84	—	—	—	—	—	—	—	—	Do. Very bad. Fur-

{ Chemical News, Feb. 3, 1888.

February, 1884	82	0·35	*0·88	—	36·20	24·17	—	—	18·75	9·41	3·95	0	0·88	4·67	—	0·83	98·86	W. T. Page. Resembles porcelain.
February 1, 1884	83	1·50	0·30	—	34·00	33·43	—	—	16·60	—	—	—	—	—	—	—	—	W. T. Page. 185·oz. bullion.
January, 1884	84	0·20	0·25	—	32·50	29·06	—	—	28·50	0·23	2·71	0	—	3·60	—	1·15	97·75	W. T. Page. 70-oz. bullion. Monoclinic crystals.
February, 1884	85	1·00	1·10	—	37·70	35·48	—	—	14·00	7·48	—	—	—	—	—	—	—	
	86	1·50	1·20	—	35·30	35·35	—	—	18·00	3·87	—	—	—	—	—	—	—	
	87	0·60	1·80	—	37·00	36·38	—	—	13·50	8·39	—	—	—	—	—	—	—	
	88	0·90	1·30	—	38·20	32·52	—	—	17·70	5·80	—	—	—	—	—	—	—	
April, 1884	89	1·40	1·60	—	36·50	38·57	—	—	15·00	7·20	—	—	—	—	—	—	—	Old Leadville slag.
	90	3·00	2·80	—	37·50	41·65	—	—	5·30	10·30	—	—	—	—	—	—	—	
	91	0 60	1·00	—	31·50	41·52	—	—	16·50	6·07	—	—	—	—	—	—	—	
	92	0·60	0·90	—	33·80	36·22	—	—	15·90	8·52	—	—	—	—	—	—	—	
	93	0·80	0·60	—	35·70	38·95	—	—	15·40	5·54	—	—	—	—	—	—	—	
	94	0·50	1·00	—	32·60	36·80	—	—	16·60	4·00	—	—	—	—	—	—	—	
	95	1·25	1·50	—	34·60	41·80	—	—	15·10	4·00	—	—	—	—	—	—	—	
	96	1·25	1·50	—	34·90	35·70	—	—	15·00	—	—	—	—	—	—	—	—	
	97	5·00	3·00	—	40·00	17·70	—	—	22·30	—	—	—	—	—	—	—	—	Three hours after "blowing in."
	98	1·20	2·10	—	38·00	27·60	—	—	11·30	—	—	—	—	—	—	—	—	
	99	—	—	—	33·00	40·00	—	—	16·00	—	—	—	—	—	—	—	—	Type for impure ores—*A*.
	100	—	—	—	33·00	33·00	—	—	23·00	—	—	—	—	—	—	—	—	Type for impure ores—*B*.

* By wet analysis.

are not adapted to lead smelting; this is particularly the case where the percentage of iron is very high and that of lime is low (see type A, Fig. *a*, and analyses Nos. 1, 2, 3, 4, and 6).

(To be continued.)

THE ESTIMATION OF IODINE.

By NORMAN McCULLOCH.

In a Paper contributed by me to the CHEMICAL NEWS (vol. lvii., p. 27), embodying the results of a few experiments on the volumetric estimation of cobalt in presence of nickel, there is a brief consideration of the reaction between nickel peroxide and iodine or its hydracid salts, involving reduction of the former to the protoxide, and oxidation of the latter to iodic acid or an iodate; and as nickel peroxide is entirely without oxidising influence on the salts of hydrochloric and hydrobromic acids, the application of these facts to the determination of iodine in presence of chlorine and bromine naturally suggested itself: the neutral or alkaline solution of the chloride, bromide, or iodide was to be treated with excess of the "peroxide," and the iodic acid in the filtered solution to admit of gravimetric or oxidimetric estimation. Not that I assumed the principle of the proposed method to be new. The process suggested by Pean de St. Gilles, and developed by Reinige (*Zeitschr. f. Anal. Chem.*, 939), involves the oxidation of the iodine as iodide in alkaline solution with a standard solution of potassium permanganate, and the complete conversion to iodate, known by the pink colour of the titrated liquid as seen on subsidence of the precipitated manganic hydroxide. Concerning this process I would point out, I think, an overlooked fact. It is generally assumed that the composition of manganic hydroxide, precipitated in virtue of the reaction between permanganate of potash and potassium iodide, is represented by the formula MnO_2, and the following is the usual equation, in which it is shown as such:—

$$KI + K_2Mn_2O_8 = KIO_3 + K_2O + 2MnO_2.$$

But this equation I am satisfied is not strictly representative of the truth, and due to the fact that manganic dioxide in presence of salts of hydriodic acid undergoes a slight but distinct reduction. This I consider proved, in a measure, by the experiments of Table I. The titre figures of four manganese determinations by the Pattinson process are there shown, but the precipitates of Experiments III. and IV. have been warmed with a weak solution of potassium iodide (10 grs. KI + 3 ozs. H_2O) previous to their solution and titration with the iron and bichrome solutions.

TABLE I.

No. of Exp.	$MnSO_4$ cryst. taken.	Iron solution used.	Bichrome sols.
I.	5 grs.	50 divs. (500 grs.)	8·4 divs.
II.	,,	,,	8·2 ,,
III.	,,	,,	8·8 ,,
IV.	,,	,,	8·8 ,,

The difference between the composition of the treated and non-treated precipitate is certainly not startlingly significant, but that difference I assert to be greater than I have yet found between duplicate experiments with the Pattinson process, finding them generally identical, and with a maximum difference of a fifth of a div. (10 grs.) only. But we obtain a striking confirmation of the partial reduction of the manganese dioxide on acidifying the potassium iodide solution used in its treatment, when the distinct liberation of iodine apparent can only be attributable to the presence of iodic acid formed by the oxidising action of the manganese dioxide. But the quantitative results of Table I. are by no means, I consider, altogether indicative of the actual extent of the reduction. Subsequent experiments satisfied me that at

least traces of the iodic acid would enter into union with the manganese precipitates to the formation of compounds stable not only in water, but in boiling sulphuric acid, and forming a source of error to be considered in interpreting the results of the above Table.

It may be reasoned, then, from these facts, that the manganese hydroxide precipitated on addition of permanganate to a potassium iodide solution, is not the *di*oxide, but a compound of lower oxygen content. Consequently two molecules of permanganate are equal to the oxidation of rather more than one molecule of iodine, and, as I suspect that the equivalent will vary slightly with circumstances of temperature, dilution, &c., I do not, summarily speaking, consider the basis of the Gilles-Reinige process a satisfactory one for the exact volumetric estimation of iodine. There were, I need scarcely say, difficulties in the way of applying potassium permanganate to the oxidation of alkaline iodide solutions (in presence of chloride or bromide) with a view to the subsequent estimation of the iodine as iodic acid. By-and-bye, it is true, these difficulties were evaded, but I describe my experiments in the order of their priority.

There was, firstly, the practical impossibility of removing by filtration the finely divided manganese hydroxide ; and secondly, and it has already been mentioned, the tendency of that oxide to combine with the iodic acid.

This latter—and the more objectional—feature I found, with the progress of my experiments, to be also exhibited by nickel peroxide, and to such an extent that in one experiment, applying it to the oxidation of 3 grains of potassium iodide dissolved in water distinctly alkalinised with caustic soda, fully one-third of the iodic acid combined with the nickel oxide, to the formation of, I think, a basic compound, and necessitating solution of the filtered and washed oxide in dilute sulphuric acid, in order to recover the iodic acid for estimation with the main portion in the filtrate. But I finally decided to abandon this process. I failed in devising a convenient and exact method for separating iodic from hydrochloric and hydrobromic acids, and the alternative lay in decomposing it with potassium iodide and applying the starch and hyposulphite method to the titration of the liberated iodine. There was not that superior simplicity and convenience in the method to recommend it for the substitution of those already in use.

Further experimental work was now a consideration of certain reactions of hydrogen peroxide as a possible basis for determining iodine in presence of chlorine and bromine.

Aqueous solutions of free chlorine and bromine, if sufficiently weak, reduce completely to hydrochloric and hydrobromic acids respectively in presence of hydrogen peroxide. This reducing action of hydrogen peroxide is facilitated by presence of bases capable of combining with the acids as formed. We observe, on the other hand, on treating strong hydrochloric or hydrobromic acid with peroxide of hydrogen (20 vols.), a slight evolution of chlorine or bromine, as the case may be. With the former acid this decomposition is not very appreciable, but sufficiently so with the latter. Concentrated solutions of acid metallic salts of hydrochloric and hydrobromic acids—for instance, the iron and aluminium compounds—show a similar tendency to evolve chlorine and bromine, but to a much less extent.

On now noting the behaviour of iodine with hydrogen peroxide, we observe a distinct dissimilarity of reaction from the other two halogens. In warm aqueous solution it incurs easy and immediate oxidation, the oxidised product being iodic acid. In presence of a base, on the other hand, we have it behaving analogously with chlorine and bromine in suffering reduction to hydriodic acid. The quantity of base necessary to insure the completeness of this reduction varies with the nature of the base employed. Potassa and soda, for instance, need be used only in slight excess of the chemical equivalent to form the odide, but with the weaker bases—say ferric oxide and alumina—we must employ a quantity greatly exceeding this proportion.

When metallic iodides are warmed in solution with hydrogen peroxide, they incur partial decomposition to free iodine and their respective oxides. But, however great the excess of hydrogen peroxide present, the liberated iodine exhibits no tendency to oxidation. An equilibrium seems established in the liquid, in which the tendency to oxidise is balanced by its tendency to reduce in presence of the liberated oxide or base.

I failed in directly turning the above facts to practical account. The object desired was the conversion of the iodine to iodic acid, but in presence of chlorine or bromine this was not to be effected completely by hydrogen peroxide. The reason of this was not far to seek. We had but to consider the well-known reaction between iodic and hydrochloric and hydrobromic acids, by which the former is reduced to iodine, and chlorine and bromine evolved from the two latter, and with this fact to combine that of the reducing influence of hydrogen peroxide on the chlorine and bromine in their conversion to hydrochloric and hydrobromic acids, and so reformed for further reducing action on the oxidised iodine. But the experiments were not altogether unfruitful in directly suggesting the way to a complete solution of the problem under investigation. It occurred to me that the above difficulty in the decomposing action of the acids, hydrochloric and hydrobromic, on the oxidised iodine, might be avoided by the use of an oxidant capable of liberating the chlorine and bromine of the reducing acids, as well as effecting the oxidation of the iodine, and by the application of heat to separate the volatile halogens from the non-volatile iodic acid. I returned to a consideration of potassium permanganate to be applied as the oxidant in the manner indicated, and the details of the procedure were as follows :—

Dry re-sublimed iodine was dissolved in a little pure caustic soda solution contained in a No. 7 Berlin porcelain basin, and after the addition of the chloride, bromide, or other substance employed (See Table II.) was treated with dry potassium permanganate, and in proportion as follows :—Of the eight molecules of oxygen contained in two molecules of potassium permanganate, three only were considered as available for the purpose required, and by simple calculation we find that the liberation of chlorine, bromine, and, as well as oxidation of, iodine from their hydracids demand a proportion of 1·48, 0·65, and 2·48 parts potassium permanganate respectively. But in practice these proportions are advisably exceeded, and may be greatly so without endangering the accuracy of the method. With the addition of the permanganate the contents of the basin are warmed, to facilitate its solution as well as its oxidising action, and the whole covered with a large glass funnel to guard against subsequent spurting. Strong sulphuric acid is now cautiously poured into the basin, and the latter placed over the flame of a Bunsen burner to concentrate its contents. The quantity of acid added should suffice not only to liberate all weaker acids, but to secure the semi-liquidity of the residue under the funnel when the evaporation has been carried to the extent of evolution of sulphuric acid fumes, and in most cases 50 to 100 grs. will form a suitable quantity. The solution to which the sulphuric acid is added is best to approximate 2 ozs. in bulk, and in about ten minutes has reached the proper degree of concentration. The evolution of sulphuric anhydride is the signal to remove the basin from the source of heat. In this basin, after washing and removing the glass funnel, we have a brown muddy liquid, containing *all* the iodine originally taken as iodic acid, and *absolutely free* from chlorine and bromine. The other constituents are sulphates of manganese and potash, free sulphuric acid, and insoluble manganic oxide, and, in now concluding with the actual estimation of the iodine, we meet with no serious obstacle to its exact gravimetric or volumetric determination. The gravimetric method first to be considered, and also as well the volumetric procedure, necessitate reduction of the oxidised iodine to

hydriodic acid, and, as there is further involved reduction and solution of the insoluble oxide of manganese, the iodine combined therewith as iodic acid passes into solution. Where the original material is of unknown composition, the procedure first to be described is preferably employed to the more expeditious volumetric method: the precipitation of the iodine as silver iodide is open to fewer sources of error, and its capabilities are already in chemical literature pretty well defined. Traces of iodine are further concentrated in a way convenient for corroborative examination. The details are as follows:—

The contents of the basin are diluted with water to reduce the proportion of iodine within 0·16 per cent, and if we avoid exceeding this percentage we are secure against loss of hydriodic acid through volatilisation. Sulphurous acid is now *quickly* added in excess, and the resulting clear solution filtered to separate traces of silica. The filtrate, raised to the boiling-point, but avoiding complete expulsion of the sulphur dioxide, is treated with excess of silver nitrate, and the precipitate thrown on to an ashless filter and well washed. The filter and contents are then dried at any temperature short of charring the filter, and the silver iodide scraped as thoroughly as possible from the paper and weighed. We may arrive at the quantity of precipitate adhering to the filter, either by burning off the paper at the lowest possible temperature and weighing the residue, or by dissolving the silver salt from the filter with an ammonium cyanide solution, evaporating to dryness in a tared platinum capsule, *gently* igniting and ascertaining its weight. I have adopted the latter procedure in the last three experiments of Table II.

TABLE II.

No. of Exp.	Iodine taken.	Other material taken. Grs.	Iodine found.
I.	0·16 grs.	$6KCl+6KBr$.	0·15 grs.
II.	0·05 ,,	,, ,,	0·04 ,,
III.	1·22 ,,	,, ,,	1·22 ,,
IV.	3·59 ,,	,, ,,	3·58 ,,
V.	3·59 ,,	,, ,,	3·58 ,,
VI.	2·86 ,,	$3KCN$.	2·86 ,,
VII.	2·75 ,,	,,	2·76 ,,
VIII.	1·70 ,,	$3KCN+K_6(C_3N_3)_4Fe_2$.	1·71 ,,

The results embodied in this table will, I think, be deemed perfectly satisfactory, and practical chemists will, I imagine, consider them as arrived at in a manner sufficiently simple and convenient. I know of no exception to the applicability of this process in commercial analysis, and granted existence of the iodine material in slightly alkaline solution, and with the addition of such a quantity of permanganate as will ensure the oxidation of all oxidisable material in both alkaline and acid solution, even traces of iodine may be determined with the utmost precision and certainty.

A couple of hours should suffice for the various operations above described, but by the use of the volumetric method which I may now discuss as an alternative procedure for the gravimetric part of the process, this time may be materially shortened.

The volumetric process is designed for, and its application recommended, only in connection with the permanganate and sulphuric acid treatment of the original material, and from the fact of its applicability only to freely acid solutions and of iodine existing as the hydracid, its originality will, I think, be inferred.

In explanation of the principle I may state as follows:—When standard potassium permanganate is run into a hydriodic acid solution containing excess of sulphuric acid, the characteristic pink colour of the permanganate disappears, while hydriodic acid remains to be reacted with and involving chemical changes represented in the accompanying equation —

$$K_2Mn_2O_8+10HI+3H_2SO_4= \\ =K_2SO_4+2MnSO_4+10I+8H_2O.$$

With the liberation of the iodine we have that element communicating to the titrated liquid a deep reddish tint, and consequently the point at which decomposition of the hydriodic acid is complete, and at which the colour of the permanganic acid ceases to disappear, is effectually masked.

To this difficulty, then, of distinguishing the "end reaction," I attribute the hitherto non-application of the facts of the above equation to the volumetric estimation of iodine, and it is in overcoming this difficulty by the simple expedient of titrating the hydriodic acid solution in presence of excess hydrocyanic acid that I now render these facts available in the new volumetric process for iodine. It is well known that hydrocyanic acid in aqueous solution, although chemically inert as regards permanganic acid, reacts actively with iodine, and that the products, cyanogen iodide and hydriodic acid, are perfectly colourless.

It is in this property of decolourising free iodine solutions that hydrocyanic acid finds its function in the volumetric process under discussion, and so effectually is the tinctorial interference of the iodine suppressed, that the "end reaction" is one of supreme sharpness, and the chemical reactions require expression in a new equation—

$$2K_2Mn_2O_8+10HI+10HCN+6H_2SO_4= \\ =2K_2SO_4+4MnSO_4+10CNI+16H_2O.$$

I prepared, for my experiments, solutions of potassium permanganate and hydrocyanic and sulphuric acids. The first mentioned was nearly normal in strength and carefully standardised in the usual way with pure iron in dilute sulphuric acid. One grain of this solution was equal to 0·00619 grs. iodine considered as the hydracid. The hydrocyanic acid solution was simply a moderately strong aqueous solution of potassium cyanide treated with excess of dilute sulphuric acid and tinged a permanent pink colour with permanganate to destroy oxidisable impurity, and the required solution of sulphuric acid was obtained by diluting the strong article with twice its volume of water and colouring likewise with permanganate. The accuracy of the process was first investigated in pure solutions, and a weighed quantity of iodine was dissolved in a little solution of pure caustic soda contained in a glass stoppered bottle, and diluted with several ounces of boiling water. Dilute sulphuric acid and, immediately afterwards, hydrocyanic acid were now added, and the stopper of the bottle quickly replaced to prevent escape of the liberated iodine. (Should that element precipitate in the liquid it is advisable to repeat the experiment with a more liberal addition of the hot water and hydrocyanic acid). The contents of the bottle were kept warm for five minutes to complete the decomposition of the iodic acid, as required by the following equation:—

$$HIO_3 + 5HI = 6I + 3H_2O.$$

They were then cooled to the ordinary temperature of the air and titrated with the standard permanganate.

The reaction between the iodine and hydrocyanic acid, to again consider it, is represented in the following equation—

$$2I+HCN=HI+CNI.$$

But under certain conditions of dilution and acidity this reaction may reverse so:—

$$HI+CNI=2I+HCN.$$

The case may be then that in the solution under titration a portion of the iodine may remain uncombined, until, with the progress of the estimation, the amount of hydriodic acid relative to that of the hydrocyanic acid is reduced within a certain proportion. This fact is practically advantageous in enabling us to titrate with freedom while the solution exhibits the slightest iodine tinge.

There is little liability to overstep the point, and excess of even one drop of the permanganate will communicate to the liquid a permanent pink colour. We must take care to ensure a sufficiency of hydrocyanic and sulphuric acids in the solution under titration, otherwise precipita-

tion of either free iodine or manganic hydroxide may ensue. The results of the process, as applied to "pure" iodine solutions, are shown in Table III.

Table III.

Iodine taken.	Iodine found.
1·90	1·90
1·71	1·72
0·21	0·22
19·93	19·88
20·57	20·52
20·75	20·74
2·76	2·76
2·90	2·89
2·21	2·20
2·19	2·19
2·17	2·16
2·21	2·21

In the three experiments footing the list the iodine was completely reduced to hydriodic acid before estimation. Sulphurous acid was employed to effect the reduction, and the excess of reducant expelled by boiling for twenty minutes in a 10-oz. flask closed in the neck with a cork fitted with an exit tube. The proportion of iodine in the boiling solution was kept within 0·16 per cent, and cooling and titration was effected without delay to minimise the oxidation of the hydriodic acid by exposure to the air. As cyanogen iodide is reducible by sulphurous acid to hydrocyanic and hydriodic acids, the iodine of the titrated solution may be re-estimated again if desired. I append, now, Table IV., in which the results are obtained by conjoining the volumetric process with the permanganate and sulphuric acid treatment of the original material. That original material must be free, I need scarcely say, from compounds of iron, copper, &c., capable of forming solutions reducible by sulphurous acid to the subsequent reduction of the standard permanganate. It will be advisable to test the reagents in a blank experiment, my permanganate of potash, for instance, containing traces of iron.

Table IV.

Iodine taken.	Other substances taken.	Iodine found.
2·44 grs.	10KCl+10KBr+3KCN.	2·46 grs.
4·20 ,,	10KCl+10KBr.	4·19 ,,
0·16 ,,	,, ,,	0·16 ,,
0·07 ,,	,, ,,	0·07 ,,

From the presence of the sulphates of manganese and potash in the experiments of this Table the end reaction of the volumetric process was barely so sharp. The pink colour exhibited a tendency to fade somewhat rapidly, but, as is well known, permanganic acid is more liable to spontaneous decomposition in presence of metallic salts. I have experimentally ascertained that in solutions of all bodies excepting those, of course, which either oxidise hydriodic acid, reduce iodine, or form insoluble iodides in acid solution, which, when tinted with one drop of standard permanganate retain their pink colour for a quarter of a minute or so, hydriodic acid may be titrated with exactness. Perfectly satisfactory results have been obtained in presence of sulphates of ammonia, iron, zinc, copper, cobalt, and chromium, &c.

Hydrobromic acid is inadmissible in even small proportion. Moderate quantities of hydrochloric acid would seem, on the contrary, to be harmless. I have repeatedly and accurately titrated hydriodic solutions containing even one-sixth their volume of strong hydrochloric acid.

I have now exhausted the facts of my work on the estimation of iodine. The principle of the volumetric method will, I think, find a wide field of usefulness in volumetric analysis, and, I trust, leisure permitting, to develop its capabilities in future papers.

Laboratory of Clyde Iron Works
(by Tollcross), Glasgow

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, January 19th, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Mr. J. Garnett Heywood was formally admitted a Fellow of the Society.

The President announced that the Council nominated as Foreign Members Professors Geuther, Ladenburg, Landolt, Nilson, Van't Hoff, Wislicenus, and Mons. Lecoq de Boisbaudran; and that these would be balloted for at the next meeting.

Certificates were read for the first time in favour of Messrs. William Herbert Barraclough, Westfield House, Thorpe Hesley, near Rotherham; Thomas Fraser Barbour, 16, Gladstone Terrace, Edinburgh; Henry Dudley Berridge, 203, Bellevue Road, Leeds; Alfred Edward Carey, M.Inst.C.E., 9, Dean's Yard, Westminster; Lewis Smith Cocking, Martin Bank, Huddersfield; Walter Hepworth Collins, 14, Bradford Chambers, Mawdsley Street, Bolton-le-Moors, Lancashire; Astley Cooper, 66, Queen's Road, Headingly; John H. J. Dagger, 3, West Bank Road, Edge Lane, Liverpool; Benjamin Henry Gerrans, Jun., 47, Aubert Park, Highbury, N.; Christopher James, Ida Villa, Swansea; J. Lewkowitsch, 6, Warwick Place, Leeds; Charles Robert Lafosse, Knolls House, Hr. Broughton, Manchester; Frederick K. S. Lowndes, 4, Plumstead Common Road, Woolwich; Thomas Maben, 2, Eskdaill Terrace, Hawick; James Mayne, 203, Oxford Street, Sydney, New South Wales; Otto Overbeck, Wootton Bassett, Wilts; Clifford Richardson, Office of the Engineer Commissioner, Washington, U.S.A.; Robert Mason Sumner, 50, Lord Street, Liverpool; Sam. Smith, 30, Commercial Street, Batley, Yorkshire; Angus Smith, 5, Antigua Street, Greenock; Arthur J. C. Waterland, Sidney Villa, South West Road, Leytonstone; John Cuthbert Welch; Emil A. Werner, 5, Church Avenue, Rathmines, Dublin.

The following papers were read:—

1. "*Morindon.*" By T. E. Thorpe, F.R.S., and W. J. Smith, M.B.

The authors have confirmed the observations of Thorpe and Greenall (*Chem. Soc. Trans.*, 1887, 52) on Morindon. Morindin, the active colouring-matter of A'l, the root-bark of *Morinda citrifolia*, yields 48·4 per cent of morindon on hydrolysis. This latter substance is not identical with alizarin, but has the composition $C_{15}H_{10}O_5$, and differs from all of the eight compounds of the same formula which are known at present.

That morindon is a methylanthracene-derivative has been proved by distilling it with zinc-dust. The methylanthracene so obtained was oxidised by chromic acid to anthraquinonecarboxylic acid having all the properties described by Liebermann.

2. "*Manganese Trioxide.*" By T. E. Thorpe, F.R.S., and F. J. Hambly.

The authors have repeated the experiments of Franke (*Journ. fur Prakt. Chemie*, 1887) on the so-called volatile oxides of manganese. They have been unable to obtain any evidence of the existence of the blue gaseous manganese tetroxide. They find, however, that *manganese trioxide* exists and can be formed by the action of a solution of potassium permanganate in sulphuric acid on dry sodium carbonate. It is a reddish-pink amorphous solid, extremely deliquescent, and stable only at a low temperature. On heating it is at once decomposed into manganese dioxide and oxygen. Water decomposes it into manganese dioxide and permanganic acid.

3. "*Note on Chatard's Process for the Estimation o Small Quantities of Manganese.*" By the same.

The authors find that the inconvenience arising from

the formation of lead carbonate in the titration of permanganic acid by ammonium oxalate may be obviated by adding sulphuric acid when boiling with the lead dioxide and nitric acid without impairing the accuracy of the results.

Discussion.

In reply to a question by the President, Mr. Hehner said that Chatard's method was an extremely delicate one; using it in the form of a colorimetric process, he had been able to detect manganese in a few m.grms. of steel containing only half a per cent of manganese.

Professor Thorpe, also in reply to the President, said that there was no reason to believe that any volatile oxide of manganese existed. Chatard's was essentially a minimetric method, and gave highly satisfactory results with very small quantities of manganese.

4. "*Contributions to the Theory of the Vitriol-chamber Process.*" By G. Lunge.

The theory has been recently advanced by Raschig that the vitriol-chamber process involves the formation in the first instance from nitrous acid and sulphurous acid of dihydroxylaminesulphonic acid, which, being acted on by nitrous acid, yields sulphuric acid and nitric oxide; this nitric oxide he considers is then re-converted into nitrous acid. This theory is regarded by the author as untenable on all points. It completely ignores the existence of nitrosyl sulphate (chamber-crystals); moreover, according to Raschig's own investigation, the dihydroxylaminesulphonic acid, as it could not possibly meet at all points with nitrous acid, would yield N_2O, of which a very large quantity would be found in the chambers, which is never the case; lastly nitric oxide, oxygen in excess, and water do not yield nitrous acid but nitric acid. Raschig's indirect proofs are equally unsatisfactory, and would at most only show that subsidiary reactions may take place to a small extent.

A true theory of the vitriol-chamber process must deal with the substances actually present and with reactions fully proved to take place. It has been already foreshadowed by the author (*Chem. Soc. Trans*, 1885, 470) in these words: "It is not, as hitherto generally assumed, NO, but N_2O_3, which acts as carrier of the oxygen in the vitriol chamber, &c." The principal reactions are:—

$$2SO_2+N_2O_3+O_2+H_2O=2SO_2(OH)(ONO).$$
$$2SO_2(OH)(ONO)+H_2O=2SO_2(OH)_2+N_2O_3.$$

These reactions are modified in the first part of the chambers by the excess of SO_2; in the last part sometimes by the complete absence of SO_2; and in some places by an excess of water. No theory can be accepted which assumes the formation of NO_2, since this gas does not occur at all in normally working chambers, and since its formation is practically excluded by the conditions which obtain in the end chambers. The question whether N_2O_3 exists as a gas or not plays only a secondary part in this discussion; but the phenomena occurring in the vitriol-chambers make it at least more probable that N_2O_3 must exist as a gas for some time before it is dissociated. At all events the gas present in the back chambers has a composition equivalent to N_2O_3, and this or NO(OH) must be introduced into the reactions. The direct reactions:

$$SO_2+N_2O_3+H_2O=SO_2(OH)_2+2NO,$$

and—

$$4NO+O_2=2N_2O_3,$$

cannot any longer be considered as important, since nitric oxide and oxygen do not yield N_2O_3 except in immediate contact with sulphuric acid—when $SO_2(OH)(ONO)$ is formed; apart from this, NO_2 must be formed in dry places, or NO_3H in the presence of water, but the presence of SO_2 modifies everything.

In the front chambers there is much NO_2 present along with N_2O_3. NO is formed by a secondary reaction (denitration) from nitrosyl sulphate:

$$2SO_2(OH)(ONO)+SO_2+2H_2O=3SO_4H_2+2NO,$$

and is principally absorbed by the direct reaction—

$$4SO_2+4NO+3O_2+2H_2O=4SO_2(OH)(ONO);$$

none of it can pass into NO_2, but some of it may pass into NO_3H, which is at once acted upon by SO_2, and converted into nitrosyl sulphate. Thus the normal vitriol-chamber process is not as hitherto understood, an alteration of reductions and oxidations, but it is a *condensation* of nitrous acid, or of NO with SO_2 and O_2 to nitrosyl sulphate, and a splitting up of the latter into sulphuric acid and N_2O_3.

Abnormally, N_2O can be formed by the reduction of NO by SO_2, but not according to Raschig's theory. This reaction in properly working chambers does not exceed an extent of 0·5 part of $NaNO_3$ on 100 of S.

Much larger losses are sometimes caused by the abnormal formation of NO_2 in the back chambers, which is due to an abnormally great supply of nitre. In this case the acid-forming process is finished too soon; the N_2O_3 does not meet with any more SO_2, and thus finds time to dissociate into NO and NO_2. Another abnormality is caused by a deficiency of nitre, which leads to losses in the shape of N_2O, of NO, and of NO_3H. Much importance is due to the fact that the normal working of the acid-forming process is a mass reaction, requiring a great excess of oxygen, without which the denitrating reactions, normally prevailing in the front chamber, set in abnormally in the back chamber. This leads to an explanation of the fact why larger chamber-space and a more copious supply of nitre compensate each other to a certain extent.

Discussion.

Dr. Alder Wright thought that an argument might perhaps be adduced in favour of the predominance of NO in the earlier chambers of a series as compared with N_2O_3, from the colour of the gases, the pale colour of which (as contrasted with the tint that would be seen were all nitrous fumes present as N_2O_3) would suggest that only a small fraction of the gases was in the higher state of oxidation. He was disposed to believe that in the chambers themselves *sulphur dioxide* was capable of reducing higher oxides of nitrogen not only to NO but even to N_2O and N_2. This was generally considered to be brought about in the Glover tower in virtue of the higher temperature, and also of the presence of As_2O_3 from pyrites; but as nitrous fumes were known to be destroyed (presumably by reduction) when no Glover tower was used, and with brimstone acid where little or no arsenic was present, it appeared to him that some other source of such loss must be looked for, and that this was to be found in the power of sulphur dioxide to reduce oxides of nitrogen to nitrous oxide at a lower temperature than usually supposed possible.

Professor Ramsay said that Dr. Lunge's remark that nitrous anhydride might act as such, or as a mixture of nitric oxide and peroxide, is, so far as the last statement is concerned, in complete accordance with Professor Ramsay's experience. A mixture of NO_2 and NO in the proportion necessary to form N_2O_3 will act as such with such reagents as water or sulphuric acid. With regard to Dr. Wright's remarks on the production of nitrous oxide, Professor Ramsay had heard from alkali makers that when "things went wrong," *i.e.*, when excess of sulphur dioxide was present, such reduction does take place.

PHYSICAL SOCIETY.

January 28th, 1888.

Prof. W. C. Adams, F.R.S., Vice-President, in the Chair.

In opening the procedings the Chairman referred to the great loss which the Society had sustained by the death of Dr. Balfour Stewart, their late President, and said his loss would be deeply felt by the whole scientific world.

The following papers were read:—

"*On the Effect of Magnetisation on the Thermo-electrical Properties of Bismuth.*" By Mr. Herbert Tomlinson.

It has been shown, by Sir Wm. Thomson and others, that the electrical resistance of an iron wire is increased when magnetised longitudinally, and similar phenomena were shown to occur in steel, nickel, cobalt, and bismuth, in a paper communicated to the Royal Society in 1882 by the author.

On comparing the results it is found that for the same intensity of magnetisation the increase of resistance of bismuth is about two thousand times that exhibited by iron. The author believes the increase of resistance of bismuth to be partly *apparent* only, and thinks that some influence similar to an opposing E.M.F. is operative, but as to its exact nature he can say nothing. Hall's phenomenon suggests itself as a possible explanation, but experiment shows that this is not the true cause. The change of dimensions due to magnetisation is found to be too small to produce the effect, and so far no satisfactory explanation has been found. On heating a rod of bismuth when under the influence of magnetising force an E.M.F. is set up from unmagnetised to magnetised across the hot junction, having a value of about 0·0022 microvolt per 1° C. difference of temperature, when the magnetising force was 226 C.G.S. units. Ettinghausen has found that a difference of temperature is produced between the two sides of a plate of bismuth placed in a magnetic field, when an electric current is passed through it, and it has also been shown that if a thermal current be substituted for the electric current a difference of potentials is produced.

"*On the Influence of Magnetism and Temperature on the Electrical Resistance of Bismuth and its Alloys with Lead and Tin.*" by M. Ed. von Aubel.

An abstract was read by Mr. Baily. Some specimens of bismuth show an increase of resistance with temperature, whilst others show a decided decrease. M. Righi is of opinion that the decrease is due to the presence of tin, but the author's experiments on alloys show that this is not the case. Magnetism always produces an increase of resistance, but its influence diminishes as the temperature rises. It is concluded that the cause of the anomaly is still to seek.

"*On a Water-Dropping Influence Machine.*" By Prof. S. P. Thompson, D.Sc.

In this apparatus only one jet of water is required, and satisfactory results are obtained without special insulation. It consists of three cylindrical metal vessels hung vertically over each other by silk strings, the highest and lowest being connected by a stiff metal wire. The highest is a small cylinder open at both ends; the lowest is an open pot which receives the water. The intermediate vessel is open at the bottom, and is provided at the top with a funnel fixed so that its central aperture is about the middle of the cylinder. The water jet, which must have a fine orifice, is inserted about half way into the uppermost vessel.

"*On the Price of the Factor of Safety in Lightning-Rods.* By Prof. S. P. Thompson."

It is shown, upon certain assumptions, that the safety against fusion varies, as—

$$\text{Total cost } x \frac{f r}{\rho d l^2 \kappa},$$

where f = temperature of fusion of material above atmosphere, r = specific thermal capacity, ρ = specific electric resistance, d = density, κ = cost in pence per lb., and l = length of the conductor. If the total cost and length are supposed to be given, the factor of safety $= \frac{f r}{\rho a^{\kappa}}$. Of the common metals iron has the greatest factor of safety, being more than four times that of copper. Such being the case the author thinks it desirable that the report of the Lightning Rod Conference be reconsidered.

"*On the Optical Demonstration of Electrical Stress.*" By Prof. A. W. Rücker, F.R.S., and Mr. C. V. Boys.

A number of lecture experiments were shown, illustrating that electrical stress exists in the dielectric separating two charged bodies. The bodies were placed in carbon disulphide, between two crossed Nicols, and on electrifying them by means of a Holtz machine light passed through the analyser. Two concentric cylinders gave a black cross on the screen, similar to those seen on interposing a plate of some uniaxal crystal, and a model illustrating a charged Leyden jar was shown.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I have given notice to bring forward, at the first meeting of the new Council, a scheme for altering the basis of entrance to the Institute.

At the present time it is necessary that any candidate for the Associateship should have studied Chemistry at one of a limited number of schools or colleges, so that any student having received his chemical education—however thorough it might have been—in any other school, college, or private laboratory, is ineligible, however willing he may be to pass the most stringent examination.

I shall be glad if any of the members of the Institute who sympathise with the idea of altering this regulation, and who have not previously communicated with me, would be good enough to give me their views as early as possible, so that I may have their moral support in bringing this matter before the Council.—I am, &c.,

William Thomson.

Royal Institution Laboratory,
Manchester, January 31, 1888.

GAS LIQUOR.

To the Editor of the Chemical News.

Sir,—The following is an analysis of a sample of "gas liquor" obtained from the Gas Works, Bradford, done in duplicate by the undermentioned, which we forward to you as it may be of interest to some of your readers. Each constituent was estimated directly. The specific gravity was 1·035 at 16° C. = 7° Tw.

The ammonium sulphide was supposed to exist as $NH_4.HS$ and the ammonium carbonate was calculated to the formula $(NH_3)_3.2Cl_2.H_2O(N_3H_{11}C_2O_5)$, although we have no proof as to its existing as such.

The results are in grms. per 100 c.c.

	Kay.	Appleyard.
Total ammonia	2·91	2·98
Volatile ammonia	2·72	2·64
Ammonium sulphocyanate	0·17	0·16
„ carbonate ..	5·74 (CO_2=3·22)	5·722 (CO_2=3·21)
Total sulphur	0·638	0·63645
Ammonium sulphide.. ..	0·936 (S=0·585)	0·901 (S=0·563)
„ sulphite.. ..	0·156 (S=0·043)	0·152 (S=0·043)
„ chloride.. ..	1·05	1·03
„ sulphate.. ..	0·0132 (S=0·0032)	0·0133 (S=0·0032)
„ thiosulphate ..	trace	trace
„ ferrocyanide ..	0·947	0·998

I am, &c.,

J. R. Appleyard.
P. Kay.

Chemistry and Dyeing Department,
Bradford Technical College, Jan. 23, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 1, January 2, 1888.

On the Speed of Transformation of Metaphosphoric Acid.—Paul Sabatier.—The author proposes the law that the speed of transformation is at every instant proportional to the mass of transformable substance present in the system.

An Alloy of Titanium and Aluminium with Silicon.—Lucien Levy.—This compound forms lamellæ, insoluble in water, alcohol, and ether, of a steel-grey colour, and of the sp. gr. 3·11. They are very brittle, and conduct heat rapidly. The compound burns in oxygen at a red heat. Superheated steam and nitric acid do not attack it, except the latter is heated. Sulphuric and hydrochloric acids attack it slightly in the cold, and more powerfully if heated.

Certain Derivatives of Cinchonine.—E. Jungfleisch and E. Léger.—The authors classify these compounds as bases soluble and insoluble in ether, and promise to give their descriptions at a future opportunity.

Action of Oxalic Acid on Cinchonine in Presence of Oxalic Acid.—MM. Caventon and Girard.—The authors describe one of the products obtained, a base soluble in ether, benzene, acetone, chloroform, and the methylic, ethylic, and amylic alcohols, but scarcely soluble in water. It melts at 125°, and turns the plane of polarised light to the left. Its centesimal composition approximates closely to that of cinchonine.

The Vapour-Density of Aluminium-Ethyl.—MM. Roux and Loüise.—Near its boiling-point it has a normal vapour-density, but at about 250° it begins to decompose, and its density becomes equal to the third of its theoretical value.

No. 2, January 9, 1888.

Researches on Ruthenium, its Oxidation, and the Dissociation of its Dioxide.—H. Debray and A. Joly.—Like osmium, ruthenium may be separated by volatilisation from the other metals of the platinum group. The physical properties of this metal are found very different from those attributed to it by Claus. Its specific gravity is found to be 12·261 instead of 8. If metallic ruthenium is heated to a bright redness in the muffle it is at first rapidly oxidised, and assumes the blue colour characteristic of the dioxide. Afterwards the absorption of oxygen becomes extremely slow, and the complete conversion of the metal into RuO_2(Ru=52) requires an increase of weight of 23·53 per cent. The formation of a sesquioxide is not admissible. If the powdered metal is heated in a slow current of oxygen at a temperature above the melting-point of silver, the whole mass becomes crystalline and a portion sublimes and is deposited in fine crystals on the sides of the tube. If the speed of the current of oxygen is increased progressively we perceive the odour of ozone or of perruthenic acid, and at last this acid distils over, and may be collected in a receiver embedded in ice. This formation of hyper-ruthenic acid requires a temperature exceeding 1000°. In the tube there is found, beside a ring of crystalline dioxide, another deposit, black and amorphous, produced at a lower temperature. The reactions of this compound identify it with a substance more highly oxidised than the dioxide, and obtained by the decomposition of hyper-ruthenic acid. Although it is obtained at very elevated temperatures the dioxide is dissociated above 1000°.

On the Ferric Phosphates and the Alumina Phosphates.—P. Hautefeuille and J. Margottet.—The authors show that a solution of silica in ter-hydrated phosphoric acid, if kept for some days at a temperature of 125°, deposits a crystalline hydrated phosphate. If kept below 125° the same solution deposits the anhydrous phosphate, which crystallises, according to the temperatures at which it is kept, in four forms mutually incompatible. The solutions of ferric oxide and of alumina in phosphoric acid present analogous phenomena. At 100° ter-hydrated phosphoric acid dissolves up to 15 per cent of ferric oxide and up to 8 per cent of alumima. If kept at 100° these solutions, in a few hours, deposit well-defined crystals. Those of iron are of a faint rose colour, and form rhombic tables derived from a klino-rhombic prism. Alumina forms colourless prismatic crystals. If the solutions of iron and alumina are quickly raised to and kept at temperatures between 150° and 200°, both bases yield crystals containing only two-thirds of the water present in the former. Those of iron form rectangular laminæ of a nacreous lustre, which act strongly upon polarised light. The crystals of alumina under the same circumstances are long doubly refractive needles. If the solutions have been kept at temperatures above 200° both the ferric and the aluminous solutions deposit anhydrous salts, which differ in crystalline form according to the temperature, but which are alike in their chemical composition.

The Use of Sulphuretted Hydrogen for purifying the Salts of Cobalt and Nickel.—H. Baubigny.—This paper will be inserted in full.

New Method of Determining Nitrites.—A. Vivier.—(See p. 33).

Action of Formic Acid upon French Oil of Turpentine.—J. Lafont.—Formic acid yields, with French oil of turpentine, reactions varying according to the process adopted for bringing the two substances into reaction. At 100° almost the sole product obtained is a polymeric carbide, diterpilene, without any rotatory power. In the cold, and on moderating the reaction, terpilene formiate is obtained in abundance, and along with it the diformic ether of terpene and a small quantity of diterpilene having a levo-rotatory action.

Synthesis in the Quinoleine Series Effected by Means of Acetylacetone and its Derivatives.—Alphonse Combes.—The substances obtained are $\alpha\gamma$-dimethyl-quinoleine and $\alpha\beta\gamma$-trimethyl-quinoleine.

Revue Universelle des Mines et de la Metallurgie. Vol. xxii., No. 2, September and October, 1887.

This issue contains no chemical matter.

MISCELLANEOUS.

The Use of E.P.S. Storage Batteries for Telegraphic Purposes.—The Exchange Telegraph Company have for six months past employed storage batteries to work the Stock Exchange "tapes" from their office in Cornhill. Two thousand primary batteries were formerly required, but their work is now adequately performed by 210 "E.P.S." accumulators, arranged in three series of 70 each. Mr. Higgins, who contributes a note to the *Electrician*, upon the subject, says, "That about 72 per cent of the electric energy supplied to the accumulators by a dynamo is returned to work the 'tapes.' This current is much steadier than that obtained from primary batteries, and shows no perceptible variation from day to day. The time necessary for charging may from the number of words transmitted be calculated to within a few minutes daily." This satisfactory application of the "E.P.S." accumulators should lead to their being very largely adopted for telephonic and telegraphic purposes, and the attention of the Post Office authorities to the matter will probably result in greater economy, while the reliability of the arrangement has been proved by Mr. Higgins in actual use for a considerable period.

NOTES AND QUERIES.

Saccharine.—Will some correspondent say if this new substance from coal-tar is being manufactured in this country, and if the manufacturers have the *sole* right. If so, what is their name and address? —A. G. M.

Ink Stains.—Ink blots, marks, &c., may be concealed by applying Chinese white once or oftener. This is very effective, and saves injury to the paper from attempts to scratch out such blots or marks. —G. A. KEYWORTH.

MEETINGS FOR THE WEEK.

MONDAY, Feb. 6th.—Medical, 8.30.
—— Society of Arts, 8. "Yeast, its Morphology and Culture," by A. Gordon Salamon, F.C.S.
—— Society of Chemical Industry, 8. "The Alkaloids, a Review of the Synthetic Methods of Preparing 'Closed Chain' Azo-carbon Compounds," by Dr. H. E. Armstrong, F.R.S. "Studies in Coal Distillation," by Lewis T. Wright, C.E.
—— Royal Institution, 5. General Monthly Meeting.
TUESDAY, 7th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
—— Society of Arts, 8. "British Columbia," by Henry Coppinger Beeton.
WEDNESDAY, 8th.—Society of Arts, 8. "The Continuation of Elementary Education," by W. Lant Carpenter, B.A.
—— Geological, 8,
—— Microscopical, 8.
—— Pharmaceutical, 8.
THURSDAY, 9th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Telegraphic Engineers, 8.
—— Mathematical, 8.
—— Royal Institution 3. "Early Secular Choral Music," by Prof. Hubert H. Parry, M.A.
—— Society of Arts, 8. "Etching and Mezzo-Tint Engraving," by Prof. Hubert Herkomer, A.R.A.
FRIDAY, 10th.—Quekett Club, 8.
—— Astronomical, 8.
—— Royal Institution, 9. "Safety Lamps in Collieries," by W. H. Preece, F.R.S.
—— Society of Arts, 8. "The Work of the Afghan Frontier Commission," by Capt. Manifold, R.A.
SATURDAY, 11th.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.
—— Physical Society, 3. Annual General Meeting. "On the Limit of Refraction in relation to Temperature and Chemical Composition," by T. Pelham Dale.

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TECHNICAL CHEMISTRY.—A Course of Lectures on the Chemistry of OILS (Mineral and Vegetable) and FATS, by Dr. A. K. MILLER, Assistant in Research Laboratory, will commence on Monday, January 23rd, at 4 p.m, Fee for the Course, £1.

For further particulars apply at the Central Institution, Exhibition Road, S.W

PHILIP MAGNUS, Organizing Director

BOROUGH OF BIRMINGHAM.
GAS DEPARTMENT.

The Gas Committee of the Corporation of BIRMINGHAM are prepared to receive Tenders for the Tar to be produced at their various Works from the 30th of June next, for a period of one or two years, or for one year and then subject to termination of the contract on three months' notice on either side.

The quantities to be dealt with in the year ending 30th June, 1889, are estimated as follows:—

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Windsor St. Works, 7300 tons.
Adderley St. Works, 2400 tons.
Swan Village Works, 2550 tons.

The Committee will receive Tenders either at a fixed price per ton or at a varying price to be calculated on the actual returns obtained from time to time on the sale of the products derived from the Tar, provided that in such case the Contractor is dealing only with the Corporation Tar.

The Corporation will be willing to let on lease Land on which Tar Works could be erected, or they would erect Works on their own land and let them to the Contractor.

Forms and Conditions of Tender may be obtained on application to me,

EDWIN SMITH, Secretary.

Borough Gas Office, Council House,
Birmingham, December 31, 1887.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1472.

FEB 88

ON THE

SPECTRUM OF THE OXYHYDROGEN FLAME.*

By G. D. LIVEING, M.A., F.R.S., Professor of Chemistry, and J. DEWAR, M.A., F.R.S., Jacksonian Professor, University of Cambridge.

In a former communication the authors described simultaneously with Dr. Huggins the strongest portion of the spectrum of water; subsequently they described a second less strong but more refrangible section of the same spectrum. M. Deslandres has noticed a third still more refrangible section. The authors now find that the spectrum extends, with diminishing intensity, into the visible region on the one hand, and far into the ultra-violet on the other. These faint parts of the spectrum they have photographed, using the dispersion of a single calcite prism and a lengthened exposure; and in the present communication they give a map of the whole extent observed, and a list of wave-lengths of upwards of 780 lines.

The spectrum exhibits the appearance of a series of rhythmical groups more or less overlapping one another, and the arrangement of the lines in these groups is shown to follow, in many cases, the law that the distances between the lines, as measured in wave-lengths, are in an arithmetic progression. M. Deslandres had previously announced that the succession of lines in A, B, and α, follow this law when their distances are measured in reciprocals of wave-lengths, and he has stated that the groups A, B, and α have counterparts in the spectrum of water. The authors find a striking resemblance between those groups and certain parts of the water spectrum, but no exact correspondence.

Dr. Grünwald, of Prague, predicted on theoretical grounds that certain lines would appear in the spectrum of water, and the authors have found a considerable number of lines which tally closely with Dr. Grünwald's predictions, some of them, in the extremities of the spectrum, being the strongest lines observed in those regions.

ON THE

PRECIPITATION OF HOP-BITTER BY LEAD ACETATE.

By ALFRED H. ALLEN.

I have read with some surprise the contribution of Mr. J. O. Arnold, entitled "Note on Mr. Allen's Method for the Detection of Hop-Substitutes in Beer," published in the Chemical News (vol. lvii., page 33). I suppose professional inexperience is the only excuse which can be made for Mr. Arnold.

Mr. Arnold bases his criticism and his three experiments on a paper by me, published in the *Analyst* for June, 1887, a copy of which Journal I enclose. Mr. Arnold is evidently familiar with the original, as he quotes several passages therefrom, and he states that I therein announced that I had "discovered a process" . . . "which is merely a slight modification of a very ancient method." This process he then describes as consisting in the precipitation of the solution with lead acetate, the removal of the excess of lead from the filtrate by sulphuretted hydrogen, and the extraction of any unprecipitated bitter principles from the concentrated solution by agitation with chloroform and ether.

It may seem almost incredible to your readers, but it is nevertheless the fact, that, notwithstanding Mr. Arnold's statement, I never claimed to have made a "discovery" at all in connection with the above process. On the contrary, after some preliminary remarks, I referred to a list of articles in English periodicals, &c., connected with the detection of hop substitutes in beer. I added that "*they* have formed the foundation of the following statements and proposals." Then, after describing in outline the methods of Dragendorff, Wittstein, and Enders, two of whom employ lead acetate, and who describe the use of immiscible solvents, such as chloroform, &c., I used the following words:—"Several of the writers on the subject state that on precipitating a beer with basic acetate of lead the hop-bitter is wholly precipitated, and hence if the concentrated filtrate has a bitter taste the presence of some hop-substitute is certain. This distinction between the bitter principles of hops and hop-substitutes is referred to in the work entitled 'Chemistry applied to the Arts and Manufactures,' edited by Chas. Vincent, and often described as the 'New Edition of Muspratt's Chemistry.' The process is also described in Wynter Blyth's work on the 'Analysis of Food,' and forms an essential part of Enders's method of detecting bitter substances, so that there is a very general consensus of opinion as to the value of the test."

With this tolerably complete acknowledgment of previous workers before him, Mr. Arnold says I announced that I had "discovered" a process which was "merely a slight modification of a very ancient method"; and further, to give the impression that I claimed the method as my own, he actually entitles his paper a "Note on Mr. Allen's Method," &c.

There being such a uniformity of opinion as to the value of the method, I contented myself with proving its power to remove hop-bitters from a limited number of beers and infusions of hops, while finding that the like principles of all, or nearly all, hop-substitutes are unprecipitated by bad acetate. Since then, however, Dr. W. Johnstone has thrown doubt on the reliability of the method, in a paper published in the *Analyst* for December, 1887. As a consequence of Dr. Johnstone's results I exchanged samples with him, and read a further note on the subject before the Society of Public Analysts, on Jan 11th. This note is already in print, and will probably be published before this sees the light. It is interesting to note that the nature of my most recent results were brought to Mr. Arnold's notice only a few days after the professed date of his paper, and some *ten days before* its publication in the Chemical News.

The following is an extract from the "Laboratory Note" referred to:—

"I examined a sample of hops which had been used by Dr. Johnstone in his experiments, and found that the treatment with lead in the manner described by me did not remove the whole of the bitter. On the other hand, I sent a portion of a sample of hops which I had already submitted to the process with satisfactory results to Dr. Johnstone, when, curiously enough, he failed to precipitate the bitter principle although I had succeeded perfectly. In a second portion of hops from the same source, though not strictly the same sample, he also found the process to fail. In the case of this sample, therefore, there is a direct conflict of evidence, Dr. Johnstone failing to make the process answer, whereas I had succeeded. But the fact that such an apparently simple operation could fail in the hands of another chemist seemed to me very serious, and I have consequently submitted to the process some eight or ten additional samples of hops. In most instances the process has succeeded fairly well, though when operating on a considerable quantity of hops the residue has usually retained a slight but distinct bitter taste. In one or two instances, how-

* Abstract of a Paper read before the Royal Society, Feb. 2nd, 1888

ever, the bitterness has been more strongly marked, as indeed it was in the sample sent me by Dr. Johnstone."

Why the method should fail in some cases and succeed in others I cannot say at present, but may point out that Mr. M. A. Adams, in the discussion on the note in question, stated that in his extensive experience basic acetate of lead never failed to remove the whole of the bitter from hop solutions, while other bitters, except chamomiles, were unaffected. It has occurred to me that this might be due to his different method of operating, which consists in removing the excess of lead by a slight excess of sulphuric acid (instead of sulphuretted hydrogen), evaporating to a small bulk, and tasting the extract without agitating with chloroform. I have tried this plan on a sample of hops which gave a sensibly bitter extract to chloroform when the lead was removed by sulphuretted hydrogen, and found all trace of bitter had disappeared, even when the concentrated solution was agitated with chloroform, and the evaporated chloroform solution tasted. It appears probable, therefore, that such traces of the hop-bitters as escape precipitation with lead are destroyed by the evaporation with very dilute acid. It remains to be seen whether similar treatment seriously affects the bitter principles of hop-substitutes. In some cases it is to be feared that it will.

The upshot of the matter is that more extended experience shows that acetate of lead cannot be relied on to remove all the bitter principle of the hop from an infusion containing it, especially when the delicacy of the method is increased by extracting the remaining traces of bitter with chloroform, instead of simply tasting the concentrated filtrate.

Sheffield, January 31, 1888.

CONTRIBUTIONS TO OUR KNOWLEDGE OF THE ELEMENT SILICON.

By H. N. WARREN, Research Analyst.

The following is an outline of a new method of preparing silicon, together with a few recent researches on the same, which designates forcibly the allotropic modifications of this element and its different properties.

For the preparation of amorphous silicon, commercial silicon eisen, cast into small bars, was suspended in a line connected to the positive wire of two ferric chloride cells, and immersed in sufficient dilute sulphuric acid for its complete solution, and in close contact with a large platinum plate connected to the negative wire. After the lapse of several hours' duration the iron had completely dissolved, leaving a residue of graphite, together with silica and amorphous silicon. The residue, after being collected and dried, was introduced into a stout glass combustion-tube, heated to redness, and a stream of carbonic anhydride maintained for some time, in order to render the silicon more dense and at the same time to deprive it of its pyrophoric nature and consume a considerable quantity of the graphite. It was afterwards introduced into an iron pipe, screwed at both ends and in contact with metallic zinc; the whole was then heated for two hours' duration to a full red-heat, cooled, and opened, the button of zinc dissolved in hydrochloric acid, when the silicon separated in the crystalline condition. A further quantity was simultaneously converted into graphitoid silicon, by fusing at a full white-heat in contact with aluminium, and parting by means of acid. Both specimens produced were identical in properties to those obtained by the ordinary method of reduction by means of sodium and potassium silico-fluoride.

It may be worthy of note that the three modifications of silicon may be converted by suitable means from the crystalline to the graphitoid, and even to the amorphous, or *vice versâ*. Thus by acting by means of an intense heat with aluminium upon potassium silico-fluoride, the whole of the silicon produced appears in the graphitoid form, but by employing an alloy of tin with 10 per cent of aluminium the reduced silicon assumes the crystalline form, tin apparently playing the same function as when metallic zinc is employed; and by employing a very small quantity of aluminium, without any tin, the silicon separated assumes the amorphous condition.

Again, when an alloy of aluminium and silver is used and a most intense white-heat is employed, and the product parted by means of nitric acid, I have frequently noticed small quantities of a bright reddish powder separate, resembling amorphous selenium and leaving an ash of silica when exposed to the oxyhydrogen flame, but whether this is a fourth modification of the element remains to be decided.

THE ACTION OF SULPHURETTED HYDROGEN ON ARSENIC ACID.

(Preliminary Notice.)

By LeRoy W. McCay, D.Sc.

When a moderately dilute solution of an alkaline arseniate is rendered distinctly acid with sulphuric acid, and treated with sulphuretted hydrogen water containing less sulphuretted hydrogen than is necessary to form, in accordance with the ordinary text-book equations, the tri- or pentasulphide of arsenic, there is generated, after permitting the tightly-corked flask containing the mixed liquids to stand about twelve hours in a cool dark place, a compound which—judging from a number of qualitative reactions—seems to be sulphoxyarsenic acid.

The following method of procedure was resorted to in preparing the compound:—

Fifty c.m.^{3} of a solution of potassium arseniate, containing 25 grms. of the salt in two litres, were brought into a little flask capable of holding about 200 c.m.^{3}, rendered moderately acid with sulphuric acid, and mixed with 25 c.m.^{3} of sulphuretted hydrogen water containing 0·25 per cent sulphuretted hydrogen. The flask was filled almost full of freshly-boiled water, tightly corked, well shaken, and put away in a dark cool place for twelve hours.

When the cork was removed all smell of sulphuretted hydrogen had disappeared, a piece of paper moistened with nitrate of silver and held over the mouth of the flask for fully five minutes remained unacted upon, nor did 10 c.m.^{3} of the solution when dropped into a little water containing a few drops of sulphate of copper alter in the least the colour of the liquid. The solution in the flask, however, was no longer perfectly clear. A decided opalescence had made its appearance, due to the separation of a small amount of finely-divided sulphur. All attempts to get rid of this sulphur by means of ordinary filtration proved fruitless. I found, however, that by adding a little pure porcelain clay to the liquid, thoroughly shaking and then filtering, a perfectly clear filtrate could be obtained. This filtrate was tested as follows:—

1. To 20 c.m.^{3} sulphuretted hydrogen was added in excess. The solution became light yellow and slightly opalescent, but there was no immediate precipitate. Indeed it was fully an hour before there was any decided evidence of the formation of a precipitate.

2. Thirty c.m.^{3} were rendered strongly acid with sulphuric acid. The solution remained clear, but upon heating to boiling, and keeping in this state for a minute or so, it began to cloud up, and soon a considerable quantity of sulphur separated out I could not distinguish any odour of sulphurous acid, nor could I obtain a reaction for the same with blue litmus paper. The test-tube containing the liquid was held under the tap until its contents were cold, and sulphuretted hydrogen in excess was then added. An immediate precipitate of trisulphide of arsenic proved the presence now of arsenious acid.

3. Fifty c.m.[3] were mixed with a solution of sulphate of copper. In the cold there was no reaction, but upon heating the contents of the beaker to boiling a small portion of the copper was thrown down in the form of a black precipitate.

4. To 50 c.m.[3] a sufficient quantity of nitrate of silver was added. There was an immediate formation of a heavy black precipitate. It was filtered off, washed thoroughly, and examined. It gave reactions for silver, arsenic, and sulphur. The filtrate from the same, after the addition of a little more nitrate of silver and an excess of ammonia, was boiled for a few minutes. There was no reduction to metallic silver, and consequently no arsenious acid present.

I desire especially to emphasize the fact that the solution upon which the above tests were performed was *clear,* strongly acid, and absolutely free from uncombined sulphuretted hydrogen.* No sulpho-salts or hyposulphites could therefore have been present. Such being the case, I am inclined to believe that there exists in the solution a compound intermediate between arsenic and sulph-arsenic acids, and that this compound is, in all likelihood, free sulphoxyarsenic acid, a potassium salt of which was actually prepared and analysed, in 1845, by Bouquet and Cloez.† These chemists, however, distinctly state that, owing to the ease with which it decomposes into sulphur and arsenious oxide, the acid corresponding to their salt cannot exist in the free state. I think it likely that, in endeavouring to separate the free acid, they used too concentrated solutions. The body acts as though its formula were of the form $H_3AsO_3{\cdot}S$, corresponding to $As_2O_3{\cdot}S_2+3H_2O$.

I have repeated the above experiment‡ and tests again and again, but the results have always been the same.

The probable existence of such a body as free sulphoxy-arsenic acid is of intense interest, inasmuch as its formation during the precipitation of arsenic, by a slow current of sulphuretted hydrogen gas from acid solutions of arseniates, would once and for all solve the mystery which ever since the time of Berzelius has been connected with the action of sulphuretted hydrogen upon arsenic acid.

I am continuing my work upon the subject, and I hope soon to be able to publish more definite results. In the meantime I reserve for myself the right to study the character of this compound, be it what it may, and at the same time investigate the *rôle* it plays in connection with the action of sulphuretted hydrogen upon arsenic acid.

John C. Green School of Science,
Princeton, N.J., January 1, 1888.

* The solution soon becomes opalescent from a separation of sulphur.

† *Annales de Chemie*, Janvier, 1845. *Journ. fur Praktische Chemie*, xxxiii., 2, P. 1.

‡ If hydrochloric acid, instead of sulphuric acid, be used for acidifying the original solution of the alkaline arseniate, the filtrate from the kaolin and sulphur can be tested with barium chloride for sulphuric acid. I have performed this test several times, but in no case have I obtained a reaction for sulphuric acid.

ON THE

USE OF SULPHURETTED HYDROGEN FOR PURIFYING THE SALTS OF COBALT AND NICKEL.

By H. BAUBIGNY.

THE author has previously shown (*Comptes Rendus*, cv., pp. 751 and 806), that the action of sulphuretted hydrogen upon solutions of cobalt and nickel depends on the conditions of the experiment, and that relatively slight modifications of the medium affect the speed of formation of the one or the other sulphide. We comprehend, therefore, that it is not possible to separate, even approximately, cobalt from nickel, or inversely, in a mixture of the salts of the two metals.

This is the case if we operate with neutral sulphates. The action, more rapid at first for cobalt, begins also with the salt of nickel, as experiment shows. The cobalt sulphide formed intervenes, as it will be further shown, in the action of the sulphuretted hydrogen upon the nickel sulphate, just as does nickel sulphide in an acid solution, and it thus promotes the decomposition of nickel sulphate. In like manner, if the mixture of the two sulphates is made in a slightly acetic solution (3 per cent of the liquid volume) the small quantity of cobalt sulphide formed at first, interfering like the former, the nickel sulphide appears almost immediately.

The only case where we might hope to realise an approximate separation by sulphuretted hydrogen is on previously acidifying with sulphuric acid; since nickel sulphate in a solution saturated with this gas at 0° is transformed at 100° into sulphide in conditions of acidity in which a cobalt sulphate is not decomposed.

The author calls *coefficient of equilibrium* the number expressed by the ratio of the weight of the free sulphuric acid to that of the sulphuric acid of the neutral sulphate in solution. When this ratio is such that the hydrogen sulphide no longer acts upon this salt at 100°, for nickel sulphate its value is about 5, whilst for cobalt sulphate it is only 2·5, when the salts are from 2 to 8 grms. per litre.

In the case of a mixture of the two salts, if a represents the weight of combined acid in the cobalt sulphate employed, and b that of the acid of the nickel sulphate, the weight, M, of free SO_3 corresponding to the coefficient of equilibrium of the system, will be $M = a \times 2{\cdot}5 + 5\,b$, and consequently, for the whole weight, M′ of free acid in the solution, less than M but greater than M″ if $M'' = a + b$, 2·5, it might seem that nickel would separate out alone as sulphate at 100°. Experiment, however, proves that this is not so. The nickel sulphide always contains relatively considerable quantities of cobalt, even if M receives its higher value. Moreover, in this case the weight of the sulphide formed becomes almost null, especially if the proportion of nickel in the saline mixture is sensibly inferior to that of cobalt.

It appears, therefore, clearly, that we cannot, by the action of sulphuretted hydrogen, precipitate either pure nickel sulphide or pure cobalt sulphide from a mixture of the salts of the two metals, even in conditions deduced from comparative experiments made upon each metal separately.

Nevertheless Dallfs, at the Congress of German Naturalists and Physicians in 1879, announced in a memoir on "The Action of Sulphuretted Hydrogen upon the Salts of the Heavy Metals" (1) that cobalt and nickel are not precipitated as sulphides in presence of the strong acids; (2) that in the case when several salts capable of being attacked by sulphuretted hydrogen are jointly present, such metals cannot be simultaneously transformed into the corresponding sulphides, and that the precipitation is always effected in such a manner that *always* one metal is completely precipitated before the separation of another begins. Upon this fact, he adds, may be founded a very convenient method for preparing pure cobalt and nickel. As sulphuretted hydrogen first completely precipitates cobalt acetate, acting upon nickel acetate only afterwards, it is merely necessary to add to the mixed solution of the nitrates of these metals a quantity of sodium acetate insufficient for the total transformation of the nitrates, and then to treat with sulphuretted hydrogen. According to the relative quantities of the two metals and that of the sodium acetate added we shall have either a solution of nickel free from cobalt, or a precipitate of cobalt sulphide free from nickel.

The assertions of Dellfs are erroneous as regards the first point. As to the second we have seen that it is not correct to say that sulphuretted hydrogen acts only in succession upon cobalt and nickel when these two metals are jointly present in combination with one and the same acid. Anthou, who first showed in a general manner that if we place an insoluble metallic sulphide in the solution

of another metal whose sulphide is more stable in an acid medium, there is effected a double decomposition, has never asserted that this exchange is complete. The author has in several cases proved that the reaction is still incomplete, even after several days.

Further, as it seemed doubtful if, under the circumstances the law of the distribution of acids and bases was not in accordance with the results of the researches of Margueritte and Malagutti, the author thought it necessary to examine if Dellfs had really come upon a special exceptional case. He mixed 11·425 grms. pure anhydrous cobalt nitrate with 2·774 grms. nickel nitrate of the same quality. To the solution were added 13 grms. pure crystalline sodium acetate, so as to convert three-fourths of the cobalt salt into acetate, according to the data of Dellfs. Lastly, the liquid, acidified with 2 c.c. of glacial acetic acid, which could only be favourable to the separation of cobalt sulphide, occupied the volume of 285 c.c. It was then treated with sulphuretted hydrogen and let stand for two hours in a closed vessel before filtering. The mother-liquor was of a rose colour. 50 c.c. of this liquor, after being separately treated with potassium nitrite in an acetic liquid to eliminate cobalt, should have given 0·199 grm. NiO if the reaction had taken place as alleged by Dellfs. But it yielded only 0·051 grm., or about one-fourth.

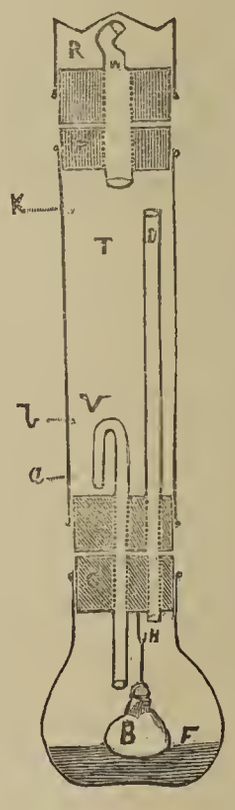
As for the precipitate which ought to have been pure cobalt sulphide, it was methodically washed by detaching it each time from the filter and agitating it with a known volume of water containing 2 per cent of acetic acid and saturated with sulphuretted hydrogen until it ought to have contained, like the mother-liquor, less than half a milligrm. of NiO. But, after drying, ignition, and converting this sulphide into nitrate to separate the cobalt by the method of double nitrite, it yielded 0·750 grm. NiO perfectly free from cobalt. The bulk of the nickel had therefore been precipitated along with the cobalt.—*Comptes Rendus* (cvi., p. 132).

AN IMPROVED MODIFICATION OF SOXHLET'S APPARATUS, FOR THE EXTRACTION OF OIL AND FAT IN PLANTS, FOODS, &c.

By JOHN J. BARLOW, Analytical Chemist.

The apparatus which I have devised, and which is shown in the sketch, is essentially a modification of Soxhlet's. It consists of a flask, F, of about 220 c.c. capacity, into which fits tightly a sound cork, C, pierced with two holes. Underneath, and in the centre of the cork C, is fixed a small hook, H (a pin bent round will do very well): to this hook H is suspended, by means of a platinum wire, a small cotton bag, B, which contains the substance to be operated on. On the top of this flask is a tube, T, about 7 inches long and 1¼ inches in diameter; at each end of this tube is fitted a good sound cork, S and P; the cork S is pierced with two holes, similar in size and position to the holes in the cork C. The holes in these two corks are best made by placing the corks together, end to end, and boring through both corks simultaneously. Into the larger of the holes in S is pushed the tube D, about 6½ inches in length and ¼ inch diameter (internal), and through the small hole in S is pushed the syphon tube V, which is about ⅛ inch internal diameter, and which has been previously bent round in the manner shown; the cork S is now pushed tightly into the end of T; at the top of this tube is fitted another cork, P, which is pierced with a hole in the centre: through this hole the tube W passes into the condenser R.

When operating I take from 2 to 6 grms. of the substance, place on a piece of good calico about 5 inches square (which has been previously well cleaned by boiling in a dilute solution of sodium carbonate, afterwards in water, dried, and weighed); the substance is tied up in this by means of a platinum wire, and then suspended to the hook H; then about 120 c.c. of ether are placed in F, the cork C pushed in tight, with bag underneath; the bottom of the bag must be at least a ½ inch from the bottom of the flask. The tube T is now fixed to the condenser R by pushing the tube W through the hole in the cork P; then the flask is fitted to T by pushing it on to the tubes V and D, the cork C fitting closely up to the cork S; the tube D must only just pass through C, and the tube V much lower. The whole apparatus is now lowered, so that F is immersed in a large beaker or other suitable vessel of water, kept at the temperature of boiling ether. When the ether boils its vapour rises up through the tube D into the condensing tube W, flows back down W, when condensed, into the tube T, where it accumulates until it gets to the bend of the tube V, at *b*, when it will syphon back into the flask, and so on *ad libitum*. After about two hours the beaker of hot water may be removed, and the flask with corks C and S, and the tubes



D and V, taken from tube T: tube V is removed, and then replaced by a larger one. which reaches up to the point K. The apparatus is again connected, and the distillation carried on till the ether fills the tube T to the point K. The flask is now slipped off C, the bag taken from the hook H, and both flask and bag placed in the air-bath, and dried at a temperature of 220° F. until weight is constant. The weight of the flask and its contents, minus the weight of the flask, gives the weight of the oil extracted. The contents of the bag are ready for operating on to obtain indigestible fibre, mineral matter, &c.

The advantages claimed for this arrangement are, 1st, that the tube T, with its fittings, acts precisely as in a delicately made Sohxlet tube, but is not so liable to fracture, is less costly, and can be easily fitted up out of loose material found in most laboratories; 2nd, the substance operated upon is always subject to the action of boiling ether or ether vapour, a point of great importance with some substances, instead of only cold ether as in other arrangements; 3rd, that by means of using a larger syphon tube, after the oil extraction, nearly all the ether can be distilled off and recovered at one operation, and

the whole extraction done in much less time than with cold ether, and with very little loss.

Oak Lane Laboratory, Whitefield, Manchester, January 21, 1888.

LEAD SLAGS.

By MALVERN W. ILES.

(Concluded from p. 45).

ALL of the above-named various types have been made by the writer, and run for some time, except the type A, which it is thought should only be used under exceedingly peculiar circumstances. It must certainly occasion much loss in both lead and silver, and aside from its being an expensive slag where siliceous ores are treated, it is also a dangerous slag to use, owing to the liability of forming "iron sows." It is thought best never to allow the percentage of lime to drop below 10 per cent.

Type B will keep the furnace in good condition and the tonnage large, but the silver and lead losses are also liable to be large. This character of slag is illustrated by analyses 12 and 17 and Fig. *a'*. The crystals are generally small rhombic plates, more or less thickened, and are often hopper-shaped, and are characterised by well-defined striations. There are conditions which make this an exceedingly economical slag. Where good limestone is not readily obtained at reasonable rates this is not a bad slag to make.

Type C, according to Dr. O. H. Hahn, has the formula $6FeO3SiO_2+2CaOSiO_2$; hence the following percentage of composition:—

	Per cent.
SiO_2	30·61
FeO	55·10
CaO	14·29
	100·00

Now, by deducting 10 per cent as an allowance for the other ingredients, there remain—

	Per cent.
SiO_2	27·55
FeO	49·59
CaO	12·86
	90·00

We therefore see that the slag belongs to the type C. This slag has been accurately described by Dr. O. H. Hahn in the *Mineral Resources of the United States* for 1882. The salient features may be briefly stated as follows:—"The proportion of calcic oxide is to the ferrous oxide as 1 : 4;" it has a marked physical appearance, a distinct crystalline form, colour black, "frequently with a rusty brown film, and a fibrous texture;" it is a good slag, both commercially and metallurgically. It is not as free from lead as type E, "and is especially adapted for smelting ores containing a large percentage of zinc." It will be readily seen that where exceedingly siliceous ores are treated, which also contain much zinc, type C cannot be regarded as an economical slag; while in localities where iron flux is abundant and the ores carry much zinc, this slag cannot be too highly recommended.

Type D is well adapted to the treatment of siliceous and very impure ores; it crystallises in the form shown in Fig. *b*, and corresponds to the formula—

$$5FeO4SiO_2+3CaO2SiO_2.$$

This gives as its percentage of composition—

	Per cent.
SiO_2	40·54
FeO	40·54
CaO	18·92
	100·00

It was found that by smelting a certain class of ores the united percentages of SiO_2, FeO, and CaO, as shown by analysis, would be 84; therefore, if we deduct 16 per cent from each of the above given percentages, there would result—

	Per cent.
SiO_2	34·06
FeO	34·06
CaO	15·90
	84·02

or practically—

	Per cen
SiO_2	34·00
FeO	34·00
CaO	16·00
	84·00

It cannot be said that the type D is the same as type F, which it closely resembles in chemical composition, since the crystalline form (Fig. *b*) and physical properties are entirely dissimilar. Very excellent results have been obtained with this slag, even when producing high-grade silver bullion. The crystals of this slag are more or less translucent, flattened, and often contain an abrupt arrow-shaped point or termination. These crystals should not for a moment be confounded with the sharp, blunt, spear-headed slag formation which is due to a marked deficiency in iron (or manganese), since the latter slag invariably contains considerable silver. The chief objection to the type D is the difficulty of obtaining it. When there is a scarcity of both iron and lime, and siliceous ores must be treated, I know of no better slag than that given by type D: these slags will invariably run very low in lead, and the silver will vary from half an ounce to two and a half ounces per ton, according to the grade of bullion and the lead charge.

Type E is a most excellent slag; it is a true singulo-silicate, and has the formula $6FeO,3SiO_2+4CaO,2SiO_2$. This gives as the percentage composition:—

	Per cent.
SiO_2	31·38
FeO	45·18
CaO	23·44
	100·00

By deducting 10 per cent as an allowance for other ingredients we would obtain—

	Per cent.
SiO_2	28·24
FeO	40·66
CaO	21·10
	90·00

It is customary to carry at least 30 per cent SiO_2 in forming this type of slag. The CaO : FeO practically as 1 : 2; the physical properties are well marked, and it crystallises as shown in Fig. *c*.

"If," says Dr. Hahn, "the proper amount of fuel has been given to the charge, it will contain neither lead nor silver; and it is my opinion that if it ever is metalliferous it is through small globules of matte dissolved in it, which have not been separated on account of lack of heat in the furnace. Running on such a slag a furnace can never get out of order except through gross carelessness." I have previously stated that *all* lead slags contain at least *some* lead and silver, although the amounts may be small, perhaps merely a trace; yet I have never seen a slag which at the same time contained only a trace of lead and silver, although I have examined a very large number of slags which were claimed to be free from these elements. This slag is used to "blow in" a furnace, to loosen up crucible obstructions, and also immediately after "barring" the furnace hangings, with markedly good results. It allows a large tonnage, requires a comparatively small

amount of fuel, and is in short an economical slag where it can be continuously run; but in certain localities, where iron flux is quite scarce, it is not as profitable a slag as the types D, F, and G.

Type F is the next well-defined slag in the lime scale (see Fig. *d*, and analyses Nos. 63, 64, 65, 66, 67, 68, and 84). The most perfect crystals I have noticed belonging to this type were carefully analysed, giving the results as stated in analysis No. 84. This is a black, lustrous slag, distinctly resinous. The crystals are rectangular prisms, remarkably translucent, and in fact where there is little manganese present they are often transparent; the tops of a number of the crystals are slightly indented or hollowed out, like salt crystals. It is an exceedingly friable slag; the powder is mouse coloured. I am indebted to Mr. H. V. Furman for a specimen of this slag; to Mr. A. F. Schneider is due the discovery of the type. This slag contained only two-tenths of an ounce silver and one-quarter of one per cent lead, and is the freest from lead and silver of any slag I have ever been able to find.

Type G is perhaps the best slag which has been discovered for the treatment of exceedingly siliceous ores. Mr. Raht, metallurgist of the Horn Silver works, Utah, produced this slag with most excellent results, working ores containing considerable baryta, alumina, and zinc. If I am properly informed, Mr. Raht is the discoverer of this most excellent type, which first gained publicity through an article by Mr. Schneider. This slag crystallises in the form shown in Fig. *e*, and will usually contain from 25 to 30 per cent CaO. The pectolitic forms of these high lime slags are sometimes good.

The slag crystallising in hexagonal plates, as shown in Fig. *g*, is sometimes good, but more often these indicate a bad slag according to my own experience. These hexagonal plates may be regarded as indicative of too high a percentage of lime, in forming the high lime slags. In attempting to flux exceedingly siliceous ores with lime alone, we will obtain slag appearances like Figs. *f*, *f'*, and *h*. But while such slags (notably Fig. *f'*) are remarkably free from lead, the silver is alarmingly high; according to the experience of others, however, the very reverse has been observed. In making this high lime slag, where there is a great deficit in either iron or manganese, the fuel and the lead charge have little or no effect in reducing the silver losses.

In conclusion it should be said that there is unmistakably some law governing the losses of both lead and silver in lead smelting. This law, it seems to me, has never as yet been clearly enunciated. We know that most highly crystalline slags are good, yet some slags which have no well defined crystalline form are also good. Furthermore, it is known that most easily fusible and fluid slags are good, and yet this is not always the case. Why should one slag be good and another be bad? To say that there should be a certain ratio existing between the silica and the bases does not solve the problem. The fuel also has a very important bearing upon this question, and it is well known that coke alone will produce a cleaner slag than a mixture of coke and charcoal. While the use of charcoal will give an increased tonnage, it will also generally cause an increased loss in silver.

The dissemination of matte globules in the slag does not to my mind satisfactorily explain the silver losses, since I have detached perfectly pure crystals from the very heart of the pot from slags of all of the above given types, and as a general thing these crystals were found to contain a larger amount of silver than the main body of the slag; the lead contents will usually be less. It was once thought that silver losses were due largely to manganese by the formation of silicate of silver (that is, the nascent oxygen given off from the manganese oxides would oxidise the silver, and this would unite with silica and thereby be carried off into the slag). I have elsewhere shown the impossibility of this supposition, and that there is no good ground for believing that such a compound has ever been produced or can be.

Can it be possible that the amount of cyanogen existing in the furnace at different times when producing certain types of slag has any bearing upon this subject? Aside from the fact that there are certain well known ratios which should exist between the silica and the bases present (for example, iron and manganese), and that lime has a most remarkable influence in cleansing the slag, we know little or nothing regarding this subject.

There seems to be some law governing the crystalline form and the amount of lime present, and it has been noticed that slags having different amounts of lime usually crystallise as follows (see p. 4 *ante*).

Slags having 3 to 5 per cent CaO crystallise like Fig. *a*.
Slags having 8 to 12 per cent CaO crystallise like Fig. *a'*.
Slags having 15 to 18 per cent CaO crystallise like Fig. *b*.
Slags having 19 to 22 per cent CaO crystallise like Fig. *c*.
Slags having 23 to 25 per cent CaO crystallise like Fig. *d*.
Slags having 25 to 27 per cent CaO crystallise like Fig. *e*.
Slags having 30 to 35 per cent CaO crystallise like Fig. *g*.

And, finally, two slags which have almost the same identical chemical composition will frequently give by assay very dissimilar results.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, February 2nd, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. Thomas Aschroft Ellwood, 46, St. Mary's Terrace, Paddington; James H. Gardiner, 6, Bloemfontein Avenue, Uxbridge Road, W.; Charles E. Munroe, Newport, Rhode Island, U.S.A.; Herbert Trewby, Langford Lodge, Clapham Park, S.W.; Thomas Edward Towerson, care of Messrs. R. Hammond and Co., Bilbao, Spain.

Professors Geuther, Ladenburg, Landolt, Nilson, Van't Hoff, Wislicenus, and Mons. Lecoq de Boisbaudran were elected Foreign Members of the Society.

The following were elected Fellows of the Society:—

Messrs. Edward Arthur Andrews, Samuel Banner, Arthur G. Bloxam, Peter Coulson Bunn, F. Barker Cooke, Albert W. Day, Philip A. Estcourt, William Cay Forsyth, Agnew Griffith, Lewis Walter Hawkins, John B. Kirkland, Thomas A. Lawson, Ph.D., Frank E. Lease, Stevenson J. C. G. Macadam, Edmund G. McBretney, W. Sedgwick Saunders, Frederick W. Shaw, Sidney Skinner, B.A., Charles F. Townsend, Alfred Edwin Tutton.

The following lecture was delivered:—

5. "*The Range of Molecular Forces.*" By A. W. Rücker, M.A., F.R.S.

In discussing the range of molecular forces it is convenient to adhere to the language of the theory of action at a distance, though with full expectation that it will ultimately be replaced by another, such as the vortex-atom theory of Sir W. Thomson, or the granular theory of Professor Osborne Reynolds, which involves only action in proximity.

If we do this, however, it must be admitted that the law of molecular action may be very complicated. It may be granted that we naturally look for simplicity in our fundamental assumptions, but it is certain that we have *à priori* no more right to expect simplicity in the results of the action of a medium than simplicity in its constitution, and that the two are not necessarily obtained together.

The largest values of the magnitude of the radius of molecular action which have been published have been deduced from observations on the condensation of gases and vapours on the surfaces of solids. Estimates on this basis made by Müller-Erzbach (*Exner's Rep.*, 1885, xxi.,

409) and Kayser (*Wied. Ann.*, 1881, xiv., 450) have ranged between 1500 and 3000 micromillimetres* ($\mu.\mu$). Such observations are open to many objections. Bunsen (*Wied.*, 1885, xxiv., 335) has shown that CO_2 will not condense on glass unless a film of water be previously formed. Warburg and Thinori (*Wied.*, 1886, xxvii,, 481, and *Wied.*, 1887, xxxi., 1006) adduce reasons for believing that the water film is largely due to uncombined or loosely combined alkalis on the surface. On clean unvarnished metals, washed glass, and quartz, the thickness of the water film which can be removed by dry air without heating does not exceed 12 $\mu.\mu$. A striking exception was agate, on which films 1640 $\mu.\mu$. thick are stated to have been formed. As this substance, however, is composed of alternate layers of quartz and a porous impure opal, the basis for an accurate calculation does not exist.

On the whole, it seems that no definite conclusions as to the magnitude of the radius of molecular action (ρ) can at present be drawn from these experiments.

Quincke (*Pogg. Ann.*, 1869, cxxxvii., 402), as is well known, by measuring the capillary elevation of liquids between glass plates coated with thin wedged-shaped films, found $\rho = 50$ $\mu.\mu$.

Plateau ("Statique des Liquides," 1873, i., 210) showed that the surface-tension of a soap-bubble, which thinned until its thickness was 118 $\mu.\mu$. was unaltered. He concluded that $\rho < 59$ $\mu.\mu$. Maxwell ("Ency. Brit.," Ed. ix., Art. "Capillary Action"), however, though by a confessedly imperfect theory, shows that the surface-tension may not change until the thickness of the film $= \rho$. Hence plateau's result may mean only that $\rho < 118$ $\mu.\mu$.

Reinold and Rücker (*Phil. Trans.*, clxxvii., Part 2, 1886, 627) have proved that the surface-tension does not alter by 0·5 per cent when the film is so thin as to show the black of the first order of Newton's colours. This appears at first sight at variance with Quincke's result, but their observations are really in remarkable accord with his.

The black and coloured parts of a film are separated by a sharp line, which proves a discontinuity in the thickness (*Proc. Roy. Soc.*, 1887, No. 182, 340). The colours, which correspond to certain thicknesses, which may be called the unstable range of thickness, are always missing.

The black part of the film has been proved by Reinold and Rücker (*Phil. Trans.*, Part II., 1883, 645) to be of a uniform thickness, which differs but little from 12 $\mu.\mu$. Sir William Thomson (*Proc. Royal Institution*) and these observers independently arrived at the conclusion that these curious phenomena are due to the fact that the surface-tension diminishes to a minimum, and then increases again when the thickness is somewhat $>$ 12 $\mu.\mu$.

The colours of the film prove that the upper limit of the range of unstable thickness is between 96 and 45 $\mu.\mu$. Quincke's result indicates that it lies between 100 and 50 $\mu.\mu$., according as we adopt Plateau's or Maxwell's views. These calculations are therefore in complete accord. Quincke's result is not an isolated fact, but is supported by observations on soap-films. The statement that 50 $\mu.\mu$.. and the radius of molecular action are of the same order of magnitude may now, perhaps, rank as an ascertained fact.

Another method of investigating the radius of molecular action is based on the phenomena of electrolytic polarisation, by observing the change in the difference of potential between a metal and a liquid in which it is immersed, when a gas or metal is deposited on it by electrolysis. In the former case we do not know the density of the gas, in the latter Oberbeck (*Wied.* 1887, xxxi., 337) concludes that a plate of platinum is completely polarised by a film of another metal of from 3 to 1 $\mu.\mu$. in thickness. The method of experiment is, however, open to objections which are indicated by Oberbeck himself.

Measurements of the thickness of the double electric layer of Helmholtz, which is closely related to the distance between two consecutive layers of molecules, have been made by Lippmann (*Compt. Rend.*, 1882, xcv., 687) Oberbeck and Falck (*Wied.*, 1884, xxi., 157).

The values they give vary between 1 and 0·02 $\mu.\mu$. Wiener (*Wied.*, 1887, xxxi., 624) has studied the alteration in the phase of light reflected from very thin silver plates deposited on mica. He finds that the effect begins to alter when the thickness is reduced to 12 $\mu.\mu$., and that it was possible to detect a silver film, the thickness of which did not exceed 0·2 $\mu.\mu$.

The diameter of a molecule is a conventional term for the mean distance of the centres of two molecules during an encounter. It may therefore be different in the liquid and gaseous states. Sir William Thomson ("Natural Philosophy," Thomson and Tait, Part II., 295, 1883), as the result of his celebrated discussion of this point, concludes that the mean distances between the centres of molecules in liquids (supposed arranged uniformly) is between 0·07 and 0·02 $\mu.\mu$., and that the latter quantity is an inferior limit to the diameter of a gaseous molecule.

The diameters of molecules (d) may be calculated if we know the mean free path (L), and the so-called condensation coefficient (v), which is the volume of the molecules contained in a unit volume of the gas.

Loschmidt (*Sitzungsber. Wien. Akad. Math. Classe*, lii., abt. 2) and O. Meyer (*Die Kinetische Theorie der Gase*, 225, 1887) have calculated d on the assumption that the molecules in a liquid practically fill the whole space it occupies. Exner (*Rep. der Physik*, xxi., 226, 1885), using a formula given by Clausius, $v = (K - 1)/(K + 2)$, when K is the specific inductive capacity, and which may be replaced by $v = (n^2 - 1)/(n^2 + 2)$, when n is the respective index, finds values of d about five times smaller.

Three independent methods of calculating the diameter of a gaseous hydrogen molecule lead to results between 0·14 and 0·11 $\mu.\mu$. The most reliable conclusions which have been reached as to molecular magnitudes may be summed up in the following table, which is reproduced from a diagram exhibited during the lecture.

$\mu.\mu$.		
118	Superior limit to ρ	Plateau. (Maxwell).
96—45	Range of unstable thickness begins	Reinold and Rücker.
59	Superior limit to ρ	Plateau.
50	Magnitude of ρ	Quincke.
12	Range of unstable thickness ends	Reinold and Rücker.
12	Action of silver plate on phase of reflected light alters..	Wiener.
10·5	Thickness of permanent water film on glass at 23° C. ..	Bunsen.
4—3	Mean distance between centres of molecules in gases at 760 m.m. and 0° C. ..	O. Meyer.
3—1	Thickness of metal films which polarise platinum	Oberbeck.
1—0·02	Thickness of electric double layer	Lippmann and Oberbeck.
0·2	Smallest appreciable thickness of silver film	Wiener.
0·14—0·11	Diameter of gaseous hydrogen molecule	Exner. O. Meyer. Van der Waals
0·07 —0·02	Mean distance between centres of liquid molecules..	W. Thomson.
0·02	Inferior limit to diameter of gaseous molecule	W. Thomson.

6. "*A New Method of obtaining Monohydrazides of α-Diketones.*" By FRANCIS R. JAPP, F.R.S., and FELIX KLINGEMANN, Ph.D.

Nitrous acid interacts with ethylic methacetoacetate, forming ethylic isonitrosopropionate, and with methacetoacetic acid forming isonotroso-ethyl-methyl ketone. The

* The micromillimetre is the millionth of a millimetre.

authors recently showed (*Proc.*, 1887, 140) that in the first of these reactions the nitrous acid may be replaced by diazo-salts, in which case an ethylic phenylhydrazine-pyruvate is obtained. They now find that the analogy between nitrous acid and diazo-salts extends also to the second reaction. By acting on sodium methacetoacetate with diazobenzene chloride they have prepared v. Pechmann's monohydrazidodiacetyl :—

$$CH_3\cdot CO\cdot CH(CH_3)\cdot COONa + C_6H_5\cdot N_2Cl = CH_3\cdot CO\cdot C\cdot CH_3 + CO_2 + NaCl$$
$$\ddot{N}\cdot NHC_6H_5.$$

The compound crystallised in short needles, melting at 133°, which agrees with v. Pechmann's determination. With phenylhydrazine it yields a compound melting at 243°, identical with v. Pechmann's dihydrazide of diacetyl m.p. 240°; v. Pechmann).

The authors intend to extend this reaction to other alkyl-acetoacetic acids.

7. "*The Formation of Dihydrazides of α-Diketones.*" By Francis R. Japp, F.R.S., and Felix Klingemann, Ph.D.

The authors find that the compound $C_{16}H_{18}N_4$, which they obtained by heating phenylhydrazinepyruvic (benzene-azopropionic) acid, and which is formed according to the equation—

$$2C_9H_{10}N_2O_2 = C_{16}H_{18}N_4 + 2CO_2 + H_2$$

(*Ber.*, xx., 2943) is identical with the dihydrazide of diacetyl, since prepared by v. Pechmann (see preceding note). Its formation from phenylhydrazine-pyruvic acid may be represented thus :—

$$\begin{matrix} CH_3\cdot C : (N_2H\cdot C_6H_5)\cdot \boxed{COOH} \\ CH_3\cdot C : (N_2H\cdot C_6H_5)\cdot \boxed{COOH} \end{matrix} = \begin{matrix} CH_3\cdot C : (N_2H\cdot C_6H_5) \\ CH_3\cdot C : (N_2H\cdot C_6H_5) \end{matrix} + CO_2 + H_2.$$

The authors have prepared the corresponding compounds from the tolylhydrazine-pyruvic acids, and are engaged in comparing them with those obtainable from diacetyl and the tolylhydrazines.

8. "*The Action of Phenylhydrazine on an Unsaturated γ-Diketone.*" By Francis R. Japp, F.R.S., and G. N. Huntly.

The saturated γ-diketones, such as acetonyl-acetone, are known to interact with 2 mols. proportions of phenylhydrazine to form colourless dihydrazides: the authors find that the unsaturated γ-diketone — anhydracetophenonebenzil—behaves differently, thus:—

$$Ph\cdot CO\cdot CPh : CH\cdot CO\cdot Ph + C_6H_5\cdot NH\cdot NH_2 = C_{28}H_{22}N_2 + H_2O + O,$$

the reduction involved in the process being probably effected at the expense of a second molecule of phenylhydrazine. The compound $C_{28}H_{22}N_2$ forms canary-yellow needles, melting with decomposition at 231°, very sparingly soluble in all the ordinary organic menstrua of low boiling-point. The authors regard it as a closed-chain compound, possibly with two nitrogen-atoms in the ring.

9. "*The supposed Identity of Rutin and Quercitin.*" By E. Schunck, Ph.D., F.R.S.

Rutin, a crystalline yellow colouring-matter contained in the leavees of garden rue (*Ruta graveolens*), was discovered by Weiss, and subsequently examined by Bornträger; by Rochleder and Hlasiwetz, who obtained it from capers, the flower-buds of *Capparis spinosa*; by Stein, who found it in Chinese yellow berries, the flower-buds of *Sophora japonica*; and by the author himself, who extracted it from the leaves of *Polygonum fagopyrum*, the common buckwheat. By most of these chemists it was held to be a distinct substance. The experiments of Hlasiwetz, however, seemed to prove that it was identical with quercitrin, and this view appears to have been generally adopted. Quercitrin having within the last few years been examined by Liebermann and others, and its true composition having been ascertained, while rutin, so far as the author knows, has not recently been made the subject of investigation, it was thought that it might be of interest again to compare the two substances, and, if found to be distinct, to ascertain wherein the difference consists.

The quercitrin employed by the author was obtained from quercitron bark, and was found to have the properties and composition assigned to it by Liebermann and Hamburger. The rutin was derived from buckwheat leaves, and though it had been in the author's collection for many years had undergone no perceptible change.

A comparative examination of the two substances led to the conclusion that they are indeed extremely similar, but that they differ essentially as regards some of their properties; they also differ in composition.

Rutin yields with acids the same products of decomposition as quercetrin, viz., quercetin and isodulcite, but not in the same relative proportion; it gives less quercetin and more isodulcite. The analyses of rutin agree with the formula $C_{42}H_{50}O_{25}$, that of quercetrin being $C_{36}H_{38}O_{20}$. The process of decomposition with acids would be represented by the equation—

$$C_{42}O_{50}H_{25} + 4H_2O = C_{24}H_{16}O_{11} + 3C_6H_{14}O_6.$$

Hence it would appear that rutin is derived from 1 mol. of quercetin and 3 mols. of isodulcite, and quercitrin from only 2 mols. of the latter and 1 mol. of the former.

10. "*The Composition of Bird-lime.*" By E. Divers, M.D., F.R.S., and M. Kawakita, M.E., F.C.S.

Bird-lime from *Ilex aquifolium* was investigated a few years ago by J. Personne, who found in it, besides vegetable *débris* and water, calcium oxalate, caoutchouc, and ethereal salts of a solid crystalline alcohol, $C_{25}H_{44}O$, m.p. 175°, with undetermined fatty acids. The authors had partly examined Japanese bird-lime before Personne published his results, and were induced to continue their work afterwards by finding that their observations, to some extent, differed from and went beyond his. Indeed their work renders it probable that Japanese bird-lime, prepared as it is, not from *I. aquifolium*, but from *I. integra*, is different in some respects in composition from European bird-lime.

They find the fatty acids of the ethereal salts to be *palmitic acid*, and, in very small quantity, a semi-solid acid, the calcium salt of which is soluble in ether and in alcohol. They have obtained two very similar alcohols by hydrolysis, one differing only slightly from Personne's *ilicic alcohol*, which they have named *ilicylic alcohol*, and have found from closely concordant analyses to have the composition $C_{22}H_{38}O$; and another, which they have named *mochylic alcohol*, from *mochi*, the Japanese word for (bird-)lime, or glutinous matter, and which agrees closely in composition with the formula $C_{26}H_{46}O$. The melting-point of this alcohol is 234° C., and that of ilicylic alcohol 172°. The two alcohols are separated from each other and from a resinoid body, $C_{26}H_{44}O$, by a tedious process of fractional dissolution with spirit of varying strengths. The resinoid body is readily soluble in spirit as weak as 80 per cent, mochylic alcohol in that of 95 per cent or stronger, and ilicylic alcohol in that of 85 to 90 per cent or stronger. The resinoid body (m.p. 110°) volatilises above 360°, apparently but little changed; ilicylic and mochylic alcohols, without change in a vacuum, at about their respective melting-points. Heated with palmitic acid, the two alcohols are converted into compounds just like purified bird-lime. Caoutchouc is also present in Japanese bird-lime to the extent of about 6 per cent; but only minute quantities of oxalates. By destructive distillation bird-lime yields much palmitic acid and a thick, oily, hydrocarbon, $C_{26}H_{44}$, besides fluorescent and more carbonaceous hydrocarbons, very little gas, and very little carbonised residue. The authors consider bird-lime to be closely allied to the *waxes* in chemical constitution.

At the next meeting, on February 16th, there will be a ballot for the election of Fellows, and the following papers will be read:—

"An Analysis of Wackenroder's Solution and a Explanation of the Formation of its Proximate Constituents." By Prof. H. Debus, F.R.S.

"Potilizin's Law of Mutual Displacement of Bromine and Chlorine." By Prof. Thorpe and J. W. Rodger.

"The Action of Phosphorus Pentachloride on Salicyl Aldedyde." By C. M. Stuart.

"Some Reactions of Nitrogen Chloro-phosphuret." By Ward Couldridge.

NOTICES OF BOOKS.

Olfactics and the Physical Senses. By Charles Henry Piesse, M.R.C.S., F.C.S., &c. London: Piesse and Lubin.

We have here a most remarkable work, worth reading not merely by men of Science, but by all intelligent persons, who may here pick up not a few valuable lessons. Amidst his argument the author introduces, in the most natural and easy manner, flashes of satire which we hope may scorch deeply in the quarters at which they are evidently aimed.

His starting-point is a denunciation of the manner in which our senses are in modern life blunted by misuse and neglect. As regards sight, he admits with satisfaction that some attention has been drawn to the abuse of sight. The labours of Mr. Brudenell Carter, F.R.C.S., unpalatable as the results have been to the School Board, are of immense value. Says our author:—"We have to put up with government by fads. That the look-out on board every ship that sails could not see a yard beyond his nose is nothing. The one point, and the only point, to some is—Did he pass the Sixth Standard? The same with our artillery men, our soldiers, and volunteers; to see clearly a mile off is nothing,—Did they pass the Sixth Standard?"

In the chapter on Touch we read:—"How useful is it to be able to pick a good silk or a good cloth, and to know that we are not being cheated by disciples of those great teachers who inform us that adulteration is another form of competition." So it doubtless is; but is this any justification?

Under "Taste" we find a very just remark:—"Probably our travelling fellow-countrymen owe their attacks of fever more to drinking water contaminated by sewage-matter than to the malarious influences which pervade certain districts of Southern Europe." This is highly probable.

The author justly condemns the table waters now imported from the Continent, from the very fact of their being vaunted as possessing medicinal properties. "We do not require drugs as diet."

In the sixth chapter Mr. Piesse comes to his main subject, Smell, assuredly the most neglected of the senses. He suggests the possibility that a large number of boilers contain dead cockroaches, "some of which probably have been daily boiled for years." We regret that the author should in this passage have used the misleading term "black beetles" for an insect which is neither a beetle nor black.

In the seventh chapter we find quoted the little-known classification of odours proposed by Linnæus. The classes are "aromatic (laurel leaves, or, more correctly, bay leaves), fragrant (jasmine), ambrosial (musk), alliaceous (garlic), fœtid (stinking goose-foot), repulsive (Solanaceæ) and nauseous odours," the last class doubtless including decomposing animal matters. Cases are given showing the tenacity with which scent-impressions are retained in the mind. We may forget the colour or the shape of some object; we may forget the peculiar tone of a human or animal voice; but a scent perceived half a century ago is at once identified when again met with.

In the paragraphs treating of the acuteness of the sense of smell in man it is stated that "less than the two-billionth part of a grain of camphor has been distinctly odorous." There is no mention of the precise experiments of Fischer and Penzoldt, in which 1-460,000,000th of a m.grm. of mercaptan was recognised.

The instances of the acuteness of scent of bloodhounds almost vanish when compared with that of certain male moths, such as *Saturnia carpini*. If a female of this species has just emerged from the chrysalis, and is placed in a closed box, males of the same species will come from distances of near a mile, though rising grounds and buildings intervene, and have even been known to find their way down the chimney to the abode of the fair prisoner.

A curious fact mentioned is that, in the opinion of hunting men, hounds are less keen scented than they were in the good old times, and that the fox more often baffles his pursuers. This fact, if fact it be, is easily explained on the principle of "natural selection." The fox which smelt most strongly would be most likely to be captured; the one less odoriferous would have a greater chance of escaping, and consequently of leaving descendants who would probably inherit his feebly odoriferous character. Hence, in a country where fox-hunting is a pursuit of long standing, the breed of foxes will be modified by degrees until they scarcely leave any smell at all.

By what process of "unnatural selection" have arisen those women in the South of Europe who dislike, and are ready to faint at, the scent of a rose, and yet find nothing offensive in dirt and putrefaction?

In the concluding chapter, on the "Harmony of the Senses," Mr. Piesse indulges in speculations on analogies between scent and sound. His father, the late Septimus Piesse, believed the seven primary odours to be camphor, lemon, jasmine, rose, almond, clove, and santal. We should rather feel disposed to search for analogies between odours and colours, associated as we find them in Nature.

We hope that Mr. Piesse's work will find readers both many and attentive. Both from the theoretical and the practical side it must prove suggestive.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Whatever alterations for the entrance to the Institute the new Council may adopt, it is to be hoped that a certificate of general knowledge as recognised for the preliminary requirements by the legal and medical profession may be a condition *sine qua non* for admission.

"Primum esse, tum philosophari."

—I am, &c.,

F.I.C.

February 6, 1888.

MR. ALLEN'S METHOD FOR THE DETECTION OF HOP SUBSTITUTES IN BEER.

To the Editor of the Chemical News.

Sir,—It appears to me that Mr. Arnold is not acquainted with all that has been said on the subject upon which he writes. In the days of high pressure it is absolutely necessary for one to have a thorough knowledge of the work he ventures to criticise, as in this instance it would have prevented Mr. Arnold reiterating in your columns

what has already been done. In October last I read a short paper before the Society of Public Analysts upon the "Detection of Hop Substitutes in Beer," and in the discussion which followed several of the members of the Society confirmed my remarks, as well as Mr. Allen, who, in a frank manner, candidly acknowledged that, since his paper was published, he was convinced that the process as advocated by himself was not all that could be desired, at the same time stating that he was glad of having the opportunity of so doing. Under the circumstances Mr. Arnold is rather behind in his criticisms contained in your issue of the 27th ult., otherwise I should not have ventured to trespass upon your valuable space.—I am, &c.,

William Johnstone.

City Central Laboratory,
13, Fish Street Hill, Jan. 30, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 3, January 16, 1888.

New Researches on the Phenomena produced by a very powerful Toxic Agent thrown off from the Lungs of Men and other Mammals along with the Expired Air.—MM. Brown-Séquard and D'Arsonval.—The authors have demonstrated that the poison is not a micro-organism, but a chemical compound of an alkaline nature, allied to the ptomaines and the leucomaines.

The Decreasing Solubility of Sulphates.—A. Etard.—It is generally admitted that the sulphates are more soluble in heat than in the cold, with the exception of the sodium, lithium, calcium, and thorium salts. The author finds that the decrease of solubility for rising temperatures, far from being exceptional, is the rule for the sulphates.

Presence of a Glycol in the Products of the Alcoholic Fermentation of Sugar.—MM. Henninger and Sanson.—M. Henninger announced, in 1882, the presence of isobutyl-glycol in a red wine from Bordeaux. It is also found in the liquids obtained from sugar, fermented by beer-yeast.

On the Methyl Acetyl-cyanacetate.—A. Haller and A. Held.—This paper does not admit of useful abstraction.

The Presence of Volatile Bases in Blood and in the Air Expired.—R. Wurtz.—The base obtained gives a precipitate with Bouchardat's reagent, and with the double mercury and potassium iodate. It forms a soluble chloroplatinate and chloraurate. The quantity of material at the author's disposal did not admit of its analysis.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 2.

Iodometric Studies.—G. Topf.—This memoir, the first or general portion of which, here inserted, extends over 80 pages, admits neither of satisfactory abstraction nor of reproduction in full.

The Definition of Normal Solutions for Volumetry.—C. Marx.—As every standard solution must contain a certain absolute weight of the effective substance the author takes, as the basis of his system, the relation of the reagent to one grm. of hydrogen.

The Use of Solidified Bromine for opening up Sulphuretted Minerals and Furnace-Products.—Dr. Albano Brand.—Solidified bromine consists of kieselguhr saturated with bromine and thus rendered very convenient for use. The author places the pulverised mineral in a boat, which is then inserted in a tube. After it follow portions of the solidified bromine, and the tube is then closed at the entrance end. The other end opens into a couple of U-tubes. The tube is gradually heated, beginning at the closed end, and as soon as the air is expelled, the boat itself is heated.

Gas Apparatus for Gasometric Analysis.—A. Ehrenberg.—This paper cannot be reproduced without the four accompanying engravings.

Efflux-Point for Burettes.—W. Leybold.—The author's arrangement cannot be explained verbally.

Practical Methods for Photographing the Spectrum.—J. M. Eder.—These methods are not described.

Determining Melting- and Solidification-Points.—M. Loviton.—From the *Bulletin de la Soc. Chimique*, to which reference is made for details.

Two Arrangements for Reading off the Volume of Gases.—H. N. Morse.—From the *American Chemical Journal.*

The Extraction of Liquids with Volatile Solvents.—A. Eiloart.—From the Chemical News.

Safety Apparatus for Extraction.—C. B. Gibson.—From the *Analyst.*

Apparatus for Fractional Distillation under Reduced Pressure.—Modifications of E. J. Bevan's apparatus, proposed by Konowalow, Gorboff, and Kessler.

A Dephlegmatisation-Capital for Fractionated Distillation.—F. Anderlini.—The apparatus here figured does not admit of intelligible description.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Acid-Resisting-Cement.—Can any reader say where an acid-resisting cement can be procured, which is used for cementing Doulton's acid-proof earthenware pipes in a laboratory?—Æolus.

MEETINGS FOR THE WEEK.

Monday, 13th.—Medical, 8.30.
—— Society of Arts, 8. "Yeast, its Morphology and Culture," by A. Gordon Salamon, F.C.S.
Tuesday, 14th.—Royal Medical and Chirurgical, 8·30.
—— Institution of Civil Engineers, 8.
—— Photographic, 8. (Anniversary).
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
—— Socety of Arts, 8. "The Principles of Design, as applied to Bookbinding," by Henry B. Wheatley.
Wednesday, 15th.—Meteorological, 7.
—— Society of Arts, 8. "Type-writers aad Type-writing," by John Harrison.
Thursday, 16th.—Royal, 4.30.
—— Society of Arts, 8. "Etching and Mezzo-Tint Engraving," by Prof. Hubert Herkomer, A.R.A.
—— Royal Institution 3. "Early Secular Choral Music," by Prof. Hubert H. Parry, M.A.
—— Chemical, 8. "On the Analysis of Wackenroder's Solution, and an Explanation of the Formation of its Proximate Constituents," by Prof. H. Debus, F.R.S. "Polilizire's Law of Mutual Displacement of Bromine and Chlorine," by Prof. Thorpe and G. W. Rodger. "The Action of Phosphorus Pentachloride on Salicyl-aldehyd," by C. M. Stuart. "Some Reactions of Nitrogen Chlorophosphuret," by Ward Coleridge.
—— Parkes Museum, 5. "Plagues, Ancient and Modern," by J. F. Payne, B.A., M.D., F.R.C.P.
Friday, 17th.—Geological, 1. (Anniversary).
—— Royal Institution, 9. "Some Developments of English Pottery During the last Fifty Years," by Sir Henry Doulton.
Saturday, 18th.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.

TO CORRESPONDENTS.

Clara Wildersbruck.—The question should be addressed to a medical paper.

THE CHEMICAL NEWS.

Vol. LVII. No. 1473.

ON THE

BEHAVIOUR OF THE SOLUBLE PHOSPHORIC ACID OF SUPERPHOSPHATES MADE FROM BELGIAN PHOSPHATES TO THE SOLVENT USED, AFTER LONG STORAGE.*

By A. BEYER, Ph.D.

In the course of a series of comparative experiments which I undertook for the purpose of determining how far the Petermann and the Wagner methods for the estimation of phosphoric acid soluble in citrate differ, when different substances are operated upon, I noticed that, in superphosphates which had been long stored, not only had a decided reversion in the phosphoric acid soluble in water taken place, but also in that obtained by the use of the solvent recommended by Wagner. This, however, was less noticeable with the form of soluble phosphoric acid found by the Petermann solvent.

As this peculiarity might easily give rise to unpleasant discrepancies and losses (affecting the consumer as well as the manufacturer) I have endeavoured by a series of experiments to determine how far the above observation is founded upon fact.

The following tables contain :—

1. A number of analytical data from experiments made with raw phosphates containing 2½ to 3 per cent oxide of iron and alumina, and intended merely to furnish some comparative results concerning the two methods.
2. A series of experiments made with phosphates similar as regards the oxide of iron and alumina to those used in 1, but mixed with different proportions of acid and tested periodically.
3. A series of experiments, *a*, *b*, and *c*, in which raw phosphates of very high percentage of oxide of iron and alumina were used; *a* and *b* with the use of different proportions of acid and tested only once; *c* with the use of different proportions of acid and tested periodically.

In regard to the methods of analysis, I may remark that I kept strictly to the directions given by Petermann† and Wagner‡. The only deviation from the original methods which I allowed myself, was in the phosphoric acid determinations for the Petermann method in those superphosphates containing the very high percentage of oxide of iron and alumina, in which cases, instead of precipitating direct with magnesia mixture, I separated the phosphoric acid in the first place by means of ammonium molybdate, but the solution in which I precipitated was prepared absolutely according to the directions. Although in the case of the superphosphates containing the smaller proportion of oxide of iron and alumina closely agreeing results were obtained by direct precipitation in the ammoniacal citrate solution, it was not so with those rich in oxide of iron and alumina, the results of which differed somewhat widely. I therefore preferred to make use of the preliminary precipitation with ammonium molybdate.

I. Oxide of Iron and Alumina in the Raw Phosphate, 2·5 to 3 per cent.

Description of superphosphate.	Soluble in water.	Soluble by Wagner method.	Soluble by Petermann method.	Total phosphoric acid.
P.c. sol. in water.	Per cent.	Per cent.	Per cent.	Per cent.
14	14·15	15·04	15·28	15·42
12	12·50	12·80	13·28	13·32
10	10·25	10·88	11·90	12·16

II. Oxide of Iron and Alumina in the Raw Phosphate, 2·5 to 3 per cent.

Proportion of raw phosphate to acid of 50° B.	Date when determination was made.	Phosphoric acid soluble in water.	Soluble by Wagner method.	Soluble by Petermann method.	Total phosphoric acid.
		P.c.	P.c.	P.c.	P.c.
100 : 85	23 10 86	9·82	11·69	12·38	12·80
	1 12 86	8·58	9·67	11 93	,,
	9 12 86	8·25	9·38	12·01	,,
	5 1 87	8·48	9·63	12·00	,,
100 : 90	23 11 86	10·10	11·69	12·51	12·54
	1 12 86	8·81	9·75	11·93	,,
	9 12 86	8·46	9·21	11·99	,,
	5 1 87	8·45	9·36	11·77	,,
100 : 95	23 11 86	10·38	11·92	12·05	12·12
	1 12 86	8·92	9·79	11·75	,,
	9 12 86	8·20	9·25	11·75	,,
	5 1 87	8·30	9·20	11·58	,,
100 : 100	23 11 86	10·27	11·72	11·94	11·99
	1 12 86	9·34	10·53	11·87	,,
	9 12 86	9·50	9·76	11·83	,,
	5 1 87	9·44	9·76	11·67	,,

III.*a*. Oxide of Iron and Alumina in the Raw Phosphate, 9·7 per cent.

Proportion of raw phosphate to acid of 50° B.	Phosphoric acid soluble in water.	Soluble by Wagner method.	Soluble by Petermann method.	Total phosphoric acid.
	Per cent.	Per cent.	Per cent.	Per cent.
100 : 90	3·65	6·91	9·44	11·52
100 : 95	4·44	7·74	9·68	11·11
100 : 100	5·17	8·06	9·84	10·82

III.*b*. Oxide of Iron and Alumina in the Raw Phosphate, 8·27 per cent.

100 : 80	6·34	—	—	14·98
100 : 85	6·81	8·96	11·21	14·65
100 : 90	8·38	8·96	11·52	14·16
100 : 95	8·65	9·50	11·76	13·76
100 : 100	8·75	9·56	12·40	13·46

III.*c*. Oxide of Iron and Alumina in the Raw Phosphate, 8·27 per cent.

Proportion of raw phosphate to acid of 52° B.	Date when analysis was made.	Phosphoric acid soluble in water.	Soluble by Wagner method.	Soluble by Petermann method.	Total phosphoric acid.
		P.c.	P.c.	P.c.	P.c.
100 : 90	13 1 87	3·13	5·81	10·00	10·62
	11 2 87	2·48	4·76	9·88	,,
	12 3 87	2·64	4·83	10·03	,,
100 : 95	13 1 87	3·58	6·09	10·31	10·57
	11 2 87	2·27	4·41	10·23	,,
	12 3 87	1·41	4·45	10·23	,,
100 : 100	13 1 87	3·83	5·63	10·04	10·05
	11 2 87	2·72	4·76	10·01	,,
	12 3 87	1·85	4·13	10·14	,,

These experiments lead to the following conclusions :—

1. The Petermann method, used with superphosphates, gives higher results, under all circumstances, than the Wagner method.
2. With superphosphates poor in oxide of iron and alumina (see Tables I. and II.) the difference between the two methods, within a short time of dissolving, is not so very great, but in eight days the phosphoric acid found by the Wagner method (concurrently with the phosphoric acid soluble in water) goes back to such an extent that of 100 parts previously soluble by the Wagner method about 17 parts become insoluble. By the use of larger proportions of acid the reversion during the first eight days is lessened, but even in that case after the lapse of fourteen days it amounts to as much; from that

* From the *Repertorium der Analytischen Chemie*, vii., 22. Translated and contributed by H. H. B. Shepherd.

† *Bulletin de la Station agricole de l'état à Gimbloux*, No. 33.

‡ Fresenius, "Quant. Analyse," 6 Aufl., 2, 703.

time forward, however, no further change takes place, either in the phosphoric acid soluble in water, or in that found by the Wagner method, even after further storing for from four to six weeks.

The determinations by the Petermann method in these superphosphates, show only a comparatively small decrease in the soluble phosphoric acid capable of being found by the method, and these differences are probably due partly to sources of error in the analyses themselves.

3. With superphosphates rich in oxide of iron and alumina one finds, shortly after dissolving, very considerable differences between the two methods (Tables III. *a*, *b*, and *c*), and on storing, these differences always increase, but here again the results by the Petermann method remain almost absolutely constant, whereas in the phosphoric acid soluble in water, as well as in that found by the Wagner method, considerable reversion takes place.

NOTE BY TRANSLATOR.—For a full description of the Wagner method referred to see, translation of Professor Wagner's original paper contributed to the *Chemiker Zeitung* in the CHEMICAL NEWS, vol. liii., p. 133.

ON AUSTRALIAN GOLD AND NATIVE METALLIC ANTIMONY.

By R. W. EMERSON MACIVOR, F.I.C., F.R.G.S., F.C.S. &c.

Gold.

PERHAPS the most extraordinary form in which gold has yet been found in quantity is that in which it occurs in a matrix of serpentine, at Gumdagai, in New South Wales. It there exists as fine flakes distributed irregularly through the rock. The first samples of stone submitted to me for assay had the appearance of having had the metal painted on thin surfaces by hand. This exceeding thinness of the gold has, however, been characteristic of all the ore—about 200 tons or so—taken from the mine during the past few years. The total gold per ton has ranged from a few pennyweights to several ounces, but, owing to the extreme firmness of the metal and the nature of the matrix, much difficulty is experienced in catching all the gold by the ordinary amalgamation process. There appears to be an unlimited supply of stone in the mine, and with suitable machinery I have no doubt but that the property would ultimately yield large profits, particularly as it also contains abundance of excellent asbestos, for which there is a good local demand. I have found some specimens of the latter mineral to contain gold in appreciable quantity.

Antimony.

While I was resident in Melbourne my friend Mr. J. Cosmo Newbury, C.M.G., enabled me to obtain some good specimens of native antimony, and of calcite and quartz containing the metal, which had been found in some part of northern Queensland, but, owing to the reticence of the finders, I could not at the time obtain information as to the exact locality from which they had been brought. Since then I have heard nothing further on the subject, nor have I seen any reference made to the discovery in the able geological and mineralogical reports of Mr. Jack, F.G S., to the Government of Queensland. That the metal occurred in something like quantity may be judged from the fact that several hundred tons were brought to Melbourne, and there run into block at the antimony smelting-works on the south banks of the Yarra.

All the specimens had the appearance of being water-worn, and in none of them could I detect either stibnite or sulphate of barium. Several of them—one weighing about 1200 grms.—consisted of the metal only, and on being broken presented the well-known laminated fracture of the metal of commerce. Others chiefly consisted of carbonate of lime, with the metal also in the laminated state, scattered unevenly throughout its mass. One specimen consisted of quartz, with two small veins of the metal running from end to end, and a few small patches between.

The antimony was singularly pure, containing mere traces of foreign substances.

St. George's Club, Hanover Square, W.

NOTE ON EXTENSIVE DISCOVERIES OF ALUM-STONE (ALUNITE) AND SULPHUR IN NEW SOUTH WALES.

By R. W. EMERSON MACIVOR, F.I.C., F.R.G.S., F.C.S., &c.

MY late colleague, Mr. S. Herbert Cox, F.G.S., the eminent mining authority of Anstralia, while exploring a property in the County of Gloucester, N.S.W., which was supposed to be auriferous, came upon an apparently limitless extent of white semi-translucent rock, which had previously been believed to be quartz, but which on examination proved to be the mineral known as alunite, and consisting of the elements of potash alum with an excess of hydrate of aluminium. On heating the stone to expel the constitutional water of the aluminic hydrate, and lixiviating the residue, a solution is obtained which on evaporation gives crystals of alum perfectly free from the faintest indication of iron. The rock yields about its own weight of alum.

One or two samples of the mineral which Mr. Cox showed me had a very slight pinkish hue, probably owing to the presence of a trace of manganese, but the great mass of the stone is perfectly white even after wasting.

Extensive works have been erected, or are in course of erection, to manufacture alum for local consumption and export. It is also intended to ship the stone to Europe, and the facilities for doing this are such that any quantity can be put down in London at less than forty shillings per ton.

Since my arrival in England I have heard from Mr. Cox that large deposits of sulphur have also been found on the property. This will render the colonial vitriol-makers independent of Sicily, from whence they have hitherto been getting their supplies of the substance.

METHODS FOR THE DETERMINATION OF NITROGEN.*

THE ABSOLUTE OR CUPRIC OXIDE METHOD.

The apparatus and reagents needed are as follows:—

Apparatus.

Combustion tube of best hard Bohemian glass, about 26 inches long and one-half inch internal diameter.

Azotometer of at least 100 cubic centimetres capacity, accurately calibrated.

Sprengel mercury air pump.

Small paper scoop, easily made from stiff writing-paper.

Reagents.

Cupric Oxide (coarse).—Wire form; to be ignited and cooled before using.

Fine Cupric Oxide.—Prepared by pounding ordinary cupric oxide in mortar.

Metallic Copper.—Granulated copper or fine copper gauze reduced and cooled in stream of hydrogen.

Sodium Bicarbonate.—Free from organic matter.

* Official Methods of Analysis of the As ociation of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

Caustic Potash Solution.—Dissolve commercial stick potash in less than its weight of water, so that crystals are deposited on cooling. When absorption of carbonic acid ceases to be prompt solution must be discarded.

Loading Tube.

Of ordinary commercial fertilisers take 1 to 2 grms. for analysis. In the case of highly nitrogenous substances the amount to be taken must be regulated by the amount of nitrogen estimated to be present. Fill tube as follows:—(1) About 2 inches of coarse cupric oxide. (2) Place on the small paper scoop enough of the fine cupric oxide to fill, after having been mixed with the substance to be analysed, about 4 inches of the tube; pour on this the substance, rinsing watch-glass with a little of the fine oxide and mix thoroughly with spatula; pour into tube, rinsing the scoop with a little fine oxide. (3) About 12 inches of coarse cupric oxide. (4) About 3 inches of metallic copper. (5) About 2½ inches of coarse cupric oxide (anterior layer). (6) Small plug of asbestos. (7) Eight-tenths to 1 grm. of sodium bicarbonate. (8) Large, loose plug of asbestos; place tube in furnace, leaving about 1 inch of it projecting; connect with pump by rubber stopper smeared with glycerin, taking care to make connection perfectly tight.

Operation.

Exhaust air from tube by means of pump. When a vacuum has been obtained, allow flow of mercury to continue, light gas under that part of tube containing metallic copper, anterior layer of cupric oxide (see 5th above) and bicarbonate of soda. As soon as vacuum is destroyed and apparatus filled with carbonic acid gas, shut off the flow of mercury and at once introduce the delivery tube of the pump into the receiving arm of the azotometer and just below the surface of the mercury seal of the azotometer, so that the escaping bubbles will pass into the air and not into the azotometer, thus avoiding the useless saturation of the caustic potash solution.

When the flow of carbonic acid has very nearly or completely ceased, pass the delivery tube down into the receiving arm, so that the bubbles will escape into the azotometer. Light the jets under the 12-inch layer of oxide, heat gently for a few moments to drive out any moisture that may be present, and bring to red heat. Heat gradually mixture of substance and oxide, lighting one jet at a time. Avoid too rapid evolution of bubbles, which should be allowed to escape at rate of about one per second or a little faster.

When the jets under mixture have all been turned on, light jets under layer of oxide at end of tube. When evolution of gas has ceased turn out all the lights except those under the metallic copper and anterior layer of oxide, and allow to cool for a few moments. Exhaust with pump and remove azotometer before flow of mercury is stopped. Break connection of tube with pump, stop flow of mercury and extinguish lights. Allow azotometer to stand for at least an hour or cool with stream of water until permanent volume and temperature are reached.

Adjust accurately the level of the KOH solution in bulb to that in azotometer, note volume of gas, temperature, and height of barometer; make calculations as usual. The labour of calculation may be much diminished by the use of the tables prepared by Messrs. Battle and Dancy, of the North Carolina Experiment Station (Raleigh, N.C.).

The above details are, with some modifications, those given in the report of the Connecticut Station for 1879 (p. 124), which may be consulted for details of apparatus, should such details be desired.

DETERMINATION BY THE METHOD OF KJELDAHL.

Reagents and Apparatus.

(1) Hydrochloric acid whose absolute strength has been determined, (*a*) by precipitating with silver nitrate and weighing the silver chloride, (*b*) by sodium carbonate, as described in Fresenius's "Quantitative Analysis," second American edition, page 680, and (*c*) by determining the amount neutralised by the distillate from a weighed quantity of pure ammonium chloride boiled with an excess of sodium hydrate.

(2) Standard ammonia whose strength, relative to the acid, has been accurately determined

(3) "C. P" sulphuric acid, specific gravity 1·83, free from nitrates and also from ammonium sulphate, which is sometimes added in the process of manufacture to destroy oxides of nitrogen.

(4) Mercuric oxide, HgO, prepared in the wet way. That prepared from mercury nitrate cannot safely be used.

(5) Potassium permanganate tolerably finely pulverised.

(6) Granulated zinc.

(7) A solution of 40 grms. of commercial potassium sulphide in one litre of water.

(8) A saturated solution of sodium hydrate free from nitrates, which are sometimes added in the process of manufacture to destroy organic matter and improve the colour of the product. That of the Greenbank Alkali Company is of good quality.

(9) Solution of cochineal prepared according to Fresenius's "Quantitative Analysis," second American edition, page 679.

(10) Burettes should be calibrated in all cases by the user.

(11) Digestion flasks of hard, moderately thick, well-annealed glass. These flasks are about 9 inches long, with a round, pear-shaped bottom, having a maximum diameter of 2½ inches, and tapering out gradually in a long neck, which is three-fourths of an inch in diameter at the narrowest part, and flared a little at the edge. The total capacity is 225 to 250 c.c.

(12) Distillation flasks of ordinary shape, 550 c.c. capacity, and fitted with a rubber stopper and a bulb tube above to prevent the possibility of sodium hydrate being carried over mechanically during distillation. This is adjusted to the tube of the condenser by a rubber tube.

(13) A condenser. Several forms have been described, no one of which is equally convenient for all laboratories. The essential thing is that the tube which carries the steam to be condensed shall be of block tin. All kinds of glass are decomposed by steam and ammonia vapour, and will give up alkali enough to impair accuracy. (See Kreussler and Henzold, *Ber. Berichte*, xvii., 34). The condenser in use in the laboratory of the Connecticut Experiment Station, devised by Professor Johnson, consists of a copper tank supported by a wooden frame, so that its bottom is 11 inches above the work-bench on which it stands. This tank is 16 inches high, 32 inches long, and 3 inches wide from front to back, widening above to 6 inches. It is provided with a water-supply tube which goes to the bottom and a larger overflow pipe above. The block tin condensing tubes, whose external diameter is ⅜ of an inch, seven in number, enter the tank through holes in the front side of it near the top, above the level of the overflow, and pass down perpendicularly through the tank and out through rubber stoppers tightly fitted into holes in the bottom. They project about 1½ inches below the bottom of the tank, and are connected by short rubber tubes with glass bulb tubes of the usual shape, which dip into glass precipitating beakers. These beakers are 6½ inches high, 3 inches in diameter below, somewhat narrower above, and of about 500 c.c. capacity. The titration can be made directly in them. The seven distillation flasks are supported on a sheet-iron shelf attached to the wooden frame that supports the tank in front of the latter. Where each flask is to stand a circular hole is cut, with three projecting lips, which support the wire gauze under the flask, and three other lips which hold the flask in place and prevent its moving laterally out of place while distillation is going on. Below this sheet-iron shelf is a metal tube carrying seven Bunsen burners, each with a stop cock like those of a gas combustion furnace. These burners are of larger diameter at the top, which prevents smoking when covered with fine gauze to prevent the flame from striking back.

(14) The stand for holding the digestion flasks consists of a pan of sheet-iron, 29 inches long by 8 inches wide, on the front of which is fastened a shelf of sheet-iron as long as the pan, 5 inches wide and 4 inches high. In this are cut six holes 1½ inches in diameter. At the back of the pan is a stout wire running lengthwise of the stand, 8 inches high, with a bend or depression opposite each hole in the shelf. The digestion flask rests with its lower part over a hole in the shelf and its neck in one of the depressions in the wire frame, which holds it securely in position. Heat is supplied by low Bunsen burners below the shelf. With a little care the naked flame can be applied directly to the flask without danger.

The Determination.

One grm. of the substance to be analysed is brought into a digestion flask with approximately 0·7 grm. of mercuric oxide and 20 c.c. of sulphuric acid. The flask is placed on the frame above described in an inclined position, and heated below the boiling-point of the acid for from five to fifteen minutes, or until frothing has ceased. The heat is then raised till the acid boils briskly. No further attention is required till the contents of the flask have become a clear liquid, which is colourless, or at least has only a very pale straw colour. The flask is then removed from the frame, held upright, and, while still hot, potassium permanganate is dropped in carefully, and in small quantity at a time, till after shaking the liquid remains of a green or purple colour. After cooling, the contents of the flask are transferred to the distilling flask with water, and to this 25 c.c. of potassium sulphide solution are added, 50 c.c. of the soda solution, or sufficient to make the reaction strongly alkaline, and a few pieces of granulated zinc. The flask is at once connected with the condenser, and the contents of the flask are distilled till all ammonia has passed over into the standard acid contained in the precipitating flask previously described, and the concentrated solution can no longer be safely boiled. This operation usually requires from twenty to forty minutes. The distillate is then titrated with standard ammonia.

The use of mercuric oxide in this operation greatly shortens the time necessary for digestion, which is rarely over an hour and a half in the case of substances most difficult to oxidise, and is more commonly less than an hour. In most cases the use of potassium permanganate is quite unnecessary, but it is believed that in exceptional cases it is required for complete oxidation, and in view of the uncertainty it is always used. Potassium sulphide removes all mercury from solution, and so prevents the formation of mercuro-ammonium compounds which are not completely decomposed by soda solution. The addition of zinc gives rise to an evolution of hydrogen, and prevents violent bumping. Previous to use the reagents should be tested by a blank experiment with sugar, which will partially reduce any nitrates that are present which might otherwise escape notice.

The following modification must be used for the determination of nitrogen in substances which contain nitrates when it is desired to use this method.

*Determination of Nitrogen, including the Nitrogen of Nitrates, by a Modified Method of Kjeldahl.**

Bring from 0·7 to 1·4 grms. of the substance to be analysed into a Kjeldahl digesting flask, add to this 36 c.c. of sulphuric acid containing 2 grms. of salicylic acid, and shake thoroughly. Then add *gradually* 3 grms. of zinc-dust, shaking the contents of the flask at the same time. Finally, add 2 or 3 drops of platinic chloride solution, and place the flask on the stand for holding the digestion flasks, where it is heated over a low flame until all danger from frothing has passed. The heat is then raised until the acid boils briskly, and the boiling continued until white fumes no longer pour out of the flask. This requires about five or ten minutes. Add now approximately 0·7 grm. mercuric oxide, and continue the boiling until the liquid in the flask is colourless or nearly so. (In case the contents of the flask are likely to become solid before this point is reached add 10 c.c. more of sulphuric acid.) Complete the oxidation with a little permanganate of potash in the usual way, and proceed with the distillation as described in the method above.

* Described by Prof M. A. Scovell.

Determination by the Ruffle Method.

Preparation of Reagents.

(1) *A standard solution of sulphuric acid*, half normal, or 19·968 grms. SO_3 per litre.

(2) *A standard solution of potassium hydrate*, half normal, or 27·991 grms. KOH per litre.

(3) *An alcoholic solution of cochineal.*

(4) *Hyposulphite mixture.*—Prepared by mixing equal parts by weight of soda-lime and finely-powdered crystallised sodium hyposulphite.

(5) *Sugar and sulphur mixture.*—This is prepared by mixing equal parts by weight of finely-powdered granulated sugar and flowers of sulphur.

(6) *Ordinary granulated soda-lime.*

Apparatus.

(1) *Combustion tubes* of hard Bohemian glass, 20 inches long and ½ inch internal diameter, drawn to a point.

(2) *Three-bulb, 6-inch U-tubes*, with glass stopcock.

(3) *Aspirator.*

Preparation.

(1) Clean and fill the U-tube with 10 c.c. of standard acid.

(2) Fit cork and glass connecting-tube. Fill the tube as follows:—(1) A loosely-fitting plug of asbestos, previously ignited, and then 1 to 1½ inches of the hyposulphite mixture. (2) The weighed portion of the substance to be analysed is intimately mixed with from 5 to 10 grms. of the sugar and sulphur mixture. (3) Pour on a piece of glazed paper, or porcelain mortar, a sufficient quantity of the hyposulphite mixture to fill about 10 inches of the tube; then add the substance to be analysed, as previously prepared; mix carefully and pour into the tube; shake down the contents of the tube; rinse off the paper or mortar with a small quantity of the hyposulphite mixture and pour into the tube; then fill up with soda-lime to within 2 inches of the end of the tube. (4) Place another plug of ignited asbestos at the end of the tube, and close with a cork. (5) Hold the tube in a horizontal position, and tap on the table until there is a gas channel all along the top of the tube. Make connection with the U-tube containing the acid, aspirate, and see that the apparatus is tight.

The combustion.—Place the prepared combustion-tube in the furnace, letting the open end project a little or so as not to burn the cork. Commence by heating the soda-lime portion until it is brought to a full red heat. Then turn up slowly jet after jet toward the outer end of the tube, so that the bubbles come off two or three a second. When the whole tube is red-hot and the evolution of the gas has ceased, and the liquid in the U-tube begins to recede towards the furnace, attach the aspirator to the other limb of the U-tube, break off the end of the tube, and draw a current of air through for a few minutes. Detach the U-tube and wash the contents into a beaker or porcelain basin, add a few drops of the cochineal solution, and titrate.

Determination by the Soda-Lime Method.

Select a tube of hard glass 14 to 16 inches long, draw one end of it to a fine point, and to the other end fit a cork, through which is passed a tube bent at right angles, the other end of which passes through a cork closing tightly one arm of a 6 inch three-bulbed U-tube with glass stopcock. Into the combustion-tube first slip a loosely-fitting plug of asbestos previously ignited, and then 1½ to

2 inches of soda-lime. Weigh out from 0·7 to 2·8 grms. of the substance to be analysed, and mix it on a piece of glazed paper or porcelain mortar with some finely pulverised soda-lime, and introduce the mixture into the combustion-tube. The paper or mortar is then rinsed out with a small quantity of soda-lime and poured into the tube. The tube is then filled up to within 1 to 2 inches of the open end with granulated soda-lime, then with a plug of ignited asbestos. A free passage is formed for the evolved gases by holding the tube in a horizontal position and tapping gently on the table. Introduce the prepared combustion-tube into the furnace, letting the open end project a little so as not to burn the cork, supporting the U-tube by a clamp. The tube is then gradually heated, commencing at the fore part, nearest the cork, and progressing slowly towards the tail. The combustion should be conducted so as to obtain a steady and uninterrupted flow of gas. When properly carried out the acid in the U-tube is never coloured. When the acid begins to recede attach the aspirator to the other limb of the U-tube and start it slowly, then break off the point of the combustion-tube and draw a current of air through the apparatus for a few minutes, in order to sweep all the ammonia into the acid,

Detach the U-tube and wash the contents into a beaker or porcelain basin, add a few drops of an alcoholic solution of cochineal, and titrate.

The standard acid and alkali to be the same as that used in the Ruffle method.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON FOR THE MONTH ENDING JANUARY 31ST, 1888.

By WILLIAM CROOKES, F.R.S.;

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To General A. De Courcy Scott, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, February 7th, 1888.

Sir,—We submit herewith the results of our analyses of the 182 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from January 1st to January 31st inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

The whole of the 182 samples examined were clear, bright, and well filtered.

Throughout the month of January the condition of the water furnished to the Metropolis by the Companies taking their supply from the Thames and the Lea, continued to be unquestionably excellent. The quantity of organic matter present in the water, as determined by estimations alike of the oxygen required for its oxidation and of the amount of its constituent carbon, was found to be very small, and exceptionally small for the period of the year. The mean proportion of organic carbon present in the Thames-derived supply, or 0·158 part, and the maximum proportion in any one sample, or 0·188 part, in 100,000 parts of the water, are almost identical with the mean and maximum respectively of the preceding month. The colour-tint of the water, though too slight to be recognisable by ordinary observation, was found, when estimated by the colorimeter, to be on the average a little in excess of that noticeable in the preceding month. On several days of the month no estimations of colour-tint could be made, by reason of the prevailing fog rendering colour observations impossible.

We are, Sir,
Your obedient Servants,
William Crookes.
William Odling.
C. Meymott Tidy.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

Annual General Meeting, February 11th, 1888.

Dr. J. H. Gladstone, F.R.S., Vice-President, in the Chair.

The Chairman read the Report of the Council for the past year, and expressed regret at the losses the Society had sustained by the deaths of Dr. Stewart (their late President), Prof. Kirchoff, Mr. Coutts Trotter, and Prof. Humpidge.

The Council regret that no increase of Members has taken place during the past year, and hope that the advantages offered by the Society may be more fully appreciated in future.

Obituary notices of Dr. B. Stewart, Mr. Coutts Trotter, and Prof. Humpidge were then read.

The Treasurer's Report shows that the financial condition of the Society is very satisfactory.

On the motion of Mr. Lant Carpenter, seconded by Mr. Inwards, the Reports were adopted.

The following gentlemen were elected Members of Council for the present year:—

President—Prof. A. W. Reinold, F.R.S.

Vice-Presidents—Dr. E. Atkinson; Prof. W. E. Ayrton, F.R.S.; Shelford Bidwell, F.R.S.; and Prof. H. McLeod, F.R.S.

Secretaries—Mr. Walter Baily, M.A., and Prof. J. Perry, F.R.S.

Treasurer—Prof. A. W. Rücker, F.R.S.

Demonstrator and Librarian—Mr. C. V. Boys.

Other Members of Council—Hon. R. Abercromby; R. H. M. Bosanquet, M.A.; W. H. Coffin; Conrad W. Cooke; Prof. F. Fuller, M.A.; W. N. Shaw, M.A.; A. Stroh; Prof. S. P. Thompson, D.Sc.; H. Tomlinson, B.A.; G. M. Whipple, B.Sc.

On taking the chair the new President expressed his sincere thanks for the great honour the Society had conferred upon him.

Prof. Fuller proposed a vote of thanks to the Lords of Committee of Council on Education for the use of the rooms and apparatus of the Normal School of Science, which was seconded by Mr. Shaw, and passed unanimously.

A cordial vote of thanks to the Council and Officers of the past year, moved by Dr. Blaikley and seconded by Prof. Ramsay, was duly acknowledged by the President.

A similar vote, proposed by Mr. Bosanquet and seconded by Mr. Hadden, to the Auditors for the past year was passed unanimously.

The meeting was then resolved into an ordinary science meeting, at which the following papers were read:—

"*On the Limit of Refraction in Relation to Temperature and Chemical Composition.*" By Mr. S. Pelham Dale.

At page 93 of Airy's "Undulatory Theory of Optics" the following formula is given as expressing the velocity of light in an isotropic medium :—

$$v = \sqrt{\left(1 - \frac{1}{2^{\frac{3}{2}}}\right)^{\frac{m}{h}}} \quad \frac{\sin \frac{\pi h}{\lambda}}{\frac{\pi h}{\lambda}}$$

where m = absolute force of attraction, h = distance between the undulating particles, and λ = wave-length. Reserving λ for wave-lengths in free ether, and l for wave-lengths in the medium, the equation is put in the form—

$$v = k \frac{\sin \theta}{\theta} \text{ where } \theta = \frac{\pi h}{l}.$$

If l increases θ diminishes, and the value of v approaches to k as a limit: hence a limit of refraction results. It is shown that the limiting value ν of the index is given by—

$$\nu = \mu \frac{\sin \theta}{\theta},$$

where μ is the index corresponding with a value of θ taken as a datum. A method of determining θ is illustrated, and it is shown that, given the indexes corresponding to two wave-lengths in a given medium, the indexes for other wave-lengths can be calculated very approximately. It is also shown that for a given medium, at different temperatures,—

$$\frac{\nu - 1}{d} = \text{constant},$$

where d = density of medium, and ν its limited index at the same temperature. In isomeric bodies the same relation obtains closely in a large number of the bodies examined. In all cases examined ν is a quantity not *very* far below μ_A.

"*Note on the Use of the Term 'Resistance' in the Description of Physical Phenomena.*" By Mr. R. H. M. BOSANQUET.

The author considers that the term "Resistance" may be conceived of quite generally as the ratio of *cause* to *effect*, and that the fact of this ratio not being constant for magnetic circuits is no reason why the term "magnetic resistance" should be discarded. He maintains that the objections to the employment of the term have been founded on the assumed requirements of *identity* instead of *analogy* between the affections of different subjects, and cannot be sustained; and that the employment of the term "resistance" in the above manner leads to some remarkable analogies which go far to justify independently the use of "*Magnetic Resistance.*"

NOTICES OF BOOKS.

On the Various Modes of Testing for Albumen in Urine. Two Lectures, with Appendix. By G. JOHNSON, M.D., F.R.S. London: Smith, Elder, and Co.

THE purpose of this little book is distinctly medical. The author recommends the testing for albumen and sugar in every case of disease, and seeks to render such investigations easier. He examines the ordinary tests, the application of heat and the use of nitric acid, and he shows under what circumstances they are likely to prove misleading. In preference he recommends the use of picric acid, as more delicate and more certain. Indeed he finds that there is no known substance occurring either in normal or abnormal urine, except albumen, which gives with picric acid a precipitate not re-soluble when heated.

In the second lecture, in which the detection of sugar is discussed, Dr. Johnson proposes as a test picric acid in conjunction with potassa, under which circumstances the picric acid is converted into picramic acid. The urine is mixed with liquor potassæ, heated to boiling, and the picric acid added, when the presence of glucose is at once shown by a deep red colour.

This method the author finds preferable to the fermentation process, and to the tests of Moore, Trommer, Fehling, and Pavy.

Contrary to the opinion of some pathologists, he finds that normal urine contains not a trace of either albumen or glucose.

A Treatise on Chemistry. By Sir H. E. ROSCOE, F.R.S., and C. SCHORLEMMER, F.R.S. Vol. III. The Chemistry of the Hydrocarbons and their Derivatives or Organic Chemistry. Part IV. London and New York: Macmillan and Co.

THIS fourth part of the third volume of the authors' great work describes the Toluene, Benzyl, Benzoyl, Hydroxybenzoyl, and Xylene groups. Like the former volumes, the part before us carries the marks of extreme care and diligence in collecting all that has been ascertained concerning the substances in question and the critical treatment of this accumulated matter. The reader is continually referred to original memoirs and dissertations where he may find complete details which could not be introduced in a general treatise.

For the advanced student and as a work of reference the value of this Treatise must remain unchallenged. But its merits render the task of the reviewer superfluous. The Index is elaborate; we have not been able to detect in it any errors.

Quantitative Chemical Analysis by Electrolysis, according to Original Methods. By Dr. ALEXANDER CLASSEN. Authorised Translation from the Second Revised and Enlarged German Edition, by V. H. HERRICK. New York: Wiley and Sons. London: Trübner and Co.

IN electrolytic analysis Prof. Classen enjoys a reputation similar to that of Mohr in volumetry, or that of Vogel in chemical spectroscopy. The present version will therefore be doubtless welcome to chemists who do not read German with facility.

The author, in his Preface, points out the advantages of electrolytic analysis in its simplicity, it occupying less of the operator's time than ordinary gravimetric processes, and in the high degree of accuracy which may be reached even by comparatively inexperienced analysts.

The first or introductory part of the work describes the various sources of an electric current useful in analytical operations. The author evidently prefers the use of a dynamo wherever the motive power is to be procured. The introduction of resistances is, however, frequently necessary, to reduce the current to the strength required. The reduction of iron, nickel, cobalt, &c., from their solutions needs stronger currents than can be easily obtained from Meininger, Daniell, or Leclanché elements.

The author figures and describes an apparatus to be attached to the dynamo, by means of which a large number of electrolytic determinations can be conducted simultaneously, requiring currents differing in strength and tension, and so that each determination is independent of the rest. According to Siemens and Halske, the constructors, the result is obtained by passing the greater part of the current through a brass wire-gauze resistance, while the individual determinations are made by small branch currents, which may be independently varied in intensity by attaching their conductors to different parts of the resistance.

As regards the process of analysis itself the author recommends the use, as negative electrode, not of a platinum crucible, but of a special thin platinum dish, holding about 225 c.c., and reserved exclusively for this purpose.

As regards the strength of the current to be employed

in different determinations, Prof. Classen remarks that all the measurements of the literature of the subject are "of the current *before* the substance to be decomposed is placed in the circuit, and not, as it ought to be, when both the voltameter and the electrolyte have been introduced."

In the next section we find instructions for the determination of those metals for which electrolysis has been found to give satisfactory results, viz., iron, cobalt, nickel, zinc, manganese, aluminium, chromium, uranium, glucinum, copper, bismuth, cadmium, lead, thallium, silver, mercury, platinum, palladium, gold, antimony, tin, arsenic, and potassium. We then proceed to instructions for the separation of these elements when they occur in combination or mixture.

In the special part we find more detailed directions for the treatment of alloys, ores, slags, furnace-products, commercial metals, &c.

The third part gives tables for calculating out the results of analyses, and a list of the few reagents needed in this department of analysis.

A number of results are appended showing the high degree of accuracy to be attained by the electrolytic method.

Revised and Illustrated Catalogue of Apparatus for Technical Instruction. London: Rigg's Technical Education Appliances, Limited.

The subjects for which these models are adapted are practical plane and solid geometry, machine construction and drawing, building construction, naval architecture, theoretical mechanics, applied mechanics, mining, metallurgy, and steam. The construction of dynamos or other electro-technical machinery, now increasing in importance, does not appear to fall within the limits of the course of instruction in view, which is evidently that of the "Science and Art Department." The models have received medals from the "Healtheries" (Educational Department) and the "Inventories," and appear to be in extensive use, not only in schools at home and in the olonies, but in Japan and in the United States.

A Hand-book of Vegetable and Mineral Products of all Countries, Imported into Great Britain, Geographically arranged, for Use in Schools. By J. H. Silberbach. Liverpool: *Journal of Commerce* Offices.

The idea of this work seems to us decidedly happy. The products are arranged in a column down the middle of each page. On the left we find the countries where they are respectively produced, and to the right are remarks on their sources, preparation, uses, &c. But the manner in which the plan has been carried out is not equally satisfactory. The localities whence products are obtained should, we submit, be arranged in the order of their importance. This is not always the case; some localities of no importance are given, whilst others of very great moment are omitted. Thus we may well be surprised at finding Asiatic Russia and Arabia given as sources of indigo, whilst Guatemala is omitted. We are not aware that sumach is imported from India. We have always known it as a product of Sicily, Italy, Spain, and latterly of some portions of the United States. Under tin we find no mention of the Queensland deposits, which are of no small importance, whilst the yields of Scandinavia and Canada are not of sufficient quantity to tell upon the markets. Perhaps the strangest omission is in the case of wool, where no mention is made of its importation from Australia. There are many more such errors which we have not space to mention.

Nor is the account given of the uses and properties of the products free from errors. Thus, alabaster is not "a carbonate of lime"; the origin of agate is very doubtful; 'baryte" is not "a metal containing valuable components, including sulphur"; beryl is not "a mineral of a blue colour"; logwood is not used as a red dye; safflower is not used for dyeing yellows, but pink and rose shades; it certainly contains, also, yellow colouring-matter, which is carefully got rid of, being useless. Tin is not a "yellow," but a white metal.

Having thus given not a catalogue but a specimen of the inaccuracies of this little work, we cannot recommend it either for schools or as a work of reference for commercial men until it has undergone a very thorough revision.

Playground of Science: a Series of Novel and Interesting Scientific Experiments, Copiously Illustrated. By Johnston Stephen. London: Truelove and Shirley.

We have here a curious little book which may, perhaps, draw the attention of not a few young people in the direction of physical science and its revelations. The experiments described are simple, and may be performed without costly appliances and without danger, but they can scarcely be pronounced as all novel. The Cartesian imps, the floating needle, the lead tree, the cup of Tantalus, &c., have given amusement to generations who have now passed away. We meet with an account of some interesting experiments devised by M. Georges Fournier, and here described under the name of "chemical vegetation." The author does not notice how totally these strange pseudo-organisms differ from crystals, the tubes and cells of which they consist being hollow, and, like the tubes and cells of organisms, containing fluids differing in composition from the enclosing solids.

There is here a curious application of the process of dialysis, which under certain circumstances might be found of practical value. The liquor in which salt provisions have been boiled may in this manner be freed from salt, and may thus be rendered fit for use.

Under the head "Atmospheric Pressure" we find an instance which makes us suspect that the author is not without a vein of dry humour. Says he, "In Scotland some people drink a concoction of whisky, sugar, and water! The bearing of this mixture upon the subject is that it is baled out in wine-glasses by means of tubes similar to pipettes, and manipulated like them, their action, of course, depending upon the pressure of the atmosphere."

The illustrations are numerous and well executed, though in one of them, showing the transmission of sounds through solids, the experimentalist looks no little alarmed at the sounds which reach his ears.

"Pepper's Ghost," now defunct, is duly explained. The author surmises that the Polytechnic ceased to exist because the ghost ceased to walk. We have heard the very opposite theory suggested, that the phantom had become rather a bore than an attraction. We cannot help feeling a slight grudge against the managers of the Polytechnic for giving this device the name "spectrescope," which the public would confound with "spectroscope," so that some troublesome confusion was occasioned.

CORRESPONDENCE.

ON THE THEORY OF THE VITRIOL-CHAMBER PROCESS.

To the Editor of the Chemical News.

Sir,—As I was not present at the last meeting of the Chemical Society, I beg leave to reply in the Chemical News to the remarks made after the reading of my paper "On the Theory of the Vitriol-Chamber Process."

I had myself mentioned the pale colour of the earlier chambers as an argument for the presence of much NO

but there is much more than "a small fraction" of the gases there in a higher state of oxidation, as proved by the numerous analyses formerly made by Naef and myself. I have frequently noticed that a gaseous mixture may contain a somewhat considerable proportion of higher oxides of nitrogen without betraying this by its colour.

It is anything but a novel idea that NO may be reduced in the chambers to N_2O, or even to N_2; the conditions of this process, viz., an excess of SO_2 *and of water*, were first established by R. Weber (*Poggendorff*, vol. cxxx., p. 329), and have been more fully investigated by myself (*Berl. Ber.*, 1881, p. 2196). I then showed that this reaction takes place equally well at the ordinary as at higher temperatures, and, since nobody else ever proved the contrary, this cannot be said to be "usually supposed." On the other hand, the assertion that such a loss is now "generally considered" to take place in the Glover tower is entirely opposed to facts. Some time ago it was certainly affirmed that such a loss did take place; but whoever has followed up the literature of that subject knows that the laboratory experiments then made were proved to be altogether inconclusive, and that no loss whatever in the shape of N_2O through the Glover tower has ever been proved, which can be easily understood, since there is there an excess of acid, not one of water, as required for the reduction of NO to N_2O. The best practical refutation of that now exploded fallacy is the fact that some of the most skilful manufacturers (of whom M. Péchiney, I believe, was the first) pass all their fresh nitric acid down the Glover tower.

The idea that As_2O_3 has anything to do with the reduction of NO to N_2O is probably a confusion with its alleged action in the Gay-Lussac tower, where it is supposed (but hardly proved) to reduce N_2O_3 to NO.—I am, &c.,

GEORGE LUNGE.

Zurich, February 6, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 4, January 23, 1888.

Action of Vanadic Acid upon the Alkaline Fluorides.—A. Ditte.—On causing vanadic acid to react upon sodium and ammonium fluorides, the author obtains double vanadio-fluorides, analogous to those obtained with potassium fluoride. Vanadic acid attacks also the fluorides of the heavy metals.

Action of Hydrochloric Acid upon Cupric Chloride.—M. Engel.—The result of this reaction is the formation of cupric chloride hydrochlorate, a compound to which the author assigns the formula $CuCl_2, +3H_2O+HCl$. It forms fine needles of a deep garnet red. On exposure to dry air this salt loses hydrochloric acid and turns green.

The Combinations of the Metallic Derivatives of the Phenols with the Mercurous and Cuprous Chlorides.—A. Gabriel Pouchet.—The author prepares these compounds on the following principle: 2 vols. of phenol, liquefied by heat, were mixed with 1 vol. caustic soda at 40° B., the mixture diluted with 10 vols. of water, and a solution of mercuric chloride is added drop by drop, constantly stirring. The precipitate formed re-dissolves at first, but by degrees there is formed a white precipitate with a slight rose shade, which is filtered, washed, and dried in a vacuum.

On the Franceines.—M. Istrati.—The author, whilst endeavouring to obtain sulphonic derivatives of benzene richer in chlorine than any previously known, has observed the production of a series of new and very interesting compounds, almost all possessing tinctorial properties, which he names franceines. All are more or less soluble in alcohol, and yield splendid coloured solutions, intensely dichroic. They dye cotton, linen, wool, and especially silk, in shades ranging from "old rose" to maroon, and even to a deep "*café au lait.*"

Determination of Bases in Industrial Phlegms.—M. Lindet.—The author determines the nitrogen by the method of Kjeldahl.

The Alcoholic Fermentation of Galactose.—E. Bourquelot.—The author finds that galactose undergoes the alcoholic fermentation in presence of glucose, levulose, or maltose.

On Galacto-carbonic Acid.—M. Maquenne.—The author has studied this acid, $C_7H_{14}O_8$, and its barium salt.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 2.

Universal Dryer.—Kirchner.—A steam-dyeing closet, the description of which is taken from the *Chemiker Zeitung.*

Filtration Apparatus.—P. Casamajor.—From the CHEMICAL NEWS.

Automatic Washing-Apparatus.—Godszatzky.—Reference is made to a figure in Vol. xix. of the *Zeitschrift* (Plate V., Fig. 8).

Gas-Generator.—J. J. Barlow.—From the CHEMICAL NEWS.

A Burette Stand with a Spiral Spring-Clip.—F. Allihn.—The inner side of the clip is pressed against the outer side by a spring contained in the tube-formed arm of the stand.

Distillatory Apparatus for the Purification of Mercury.—H. N. Morse.—From the *American Chemical Journal.*

The Application of Hydrogen Peroxide in Analytical Chemistry.—A Classen and O. Bauer propose to determine the sulphur in all sulphides which, when boiled with hydrochloric acid, dissolve with evolution of sulphuretted hydrogen by means of the oxidation of hydrogen sulphide to sulphuric acid in contact with alkaline hydrogen peroxide. This reagent, however, when free from sulphuric acid, is costly. S. Eliasberg mixes the hydrogen peroxide, accurately neutralised with a measured quantity of an alkali of known strength, and after the sulphuretted hydrogen has been oxidised he determines the excess of alkali with a standard acid.

Separation of Alumina from Titanic Acid.—F. A. Gooch.—From *American Academy of Arts and Sciences.*

Quantitative Separation of Tellurium and Selenium.—E. Divers and M. Schimosé.—From the *Journal of the Chemical Society.*

Volumetric Determination of Soluble Phosphoric Acid in Superphosphates.—A. Emmerling.—This memoir will be inserted at some length.

Detection of Inverted Sugar in Presence of Cane-Sugar.—P. Degener and Schweitzer.—The authors use as a reagent a solution of copper carbonate in a solution of potassium dicarbonate.

The General Applicability of Kjeldahl's Method for the Determination of Nitrogen.—C. Arnold.—The author finds that in azo- and amido-azo-compounds, in nitrites and nitrates, the result is frequently decidedly too low. In diazo-compounds no ammonia is formed. In case of nitrates satisfactory results were obtained by the simultaneous addition of sugar and an excess of benzoic acid.

Determination of Sulphuretted Hydrogen.—J. A. Wanklyn.—From the *Journal of the Society of Chemical Industry.*

Analysis of Gas-waters.—S. Dyson.—From the *Journal of the Society of Chemical Industry.*

Examination of Soap-powders.—Finkener uses a mixture of equal volumes of alcohol at 85 per cent, and of strong acetic acid. He heats 1 grm. of the soap-powder to a boil with 10 to 15 c.c. of this liquid, whereby pure soap-powders give a clear solution, and impurities subside. The clear liquid is decanted off and mixed with twice its volume of water, when the fatty acids separate out on the surface. Carbonates, earthy or alkaline, betray themselves by effervescence.

Distinction between Vegetable and Animal Fibres.—Hans Molisch.—The method depends on the conversion of cellulose into sugar and the detection of the latter. About 0·01 grm. of the fibre, previously well boiled in water and rinsed, is mixed with 1 c.c. water, 2 drops of an alcoholic solution (15 to 20 per cent) of α-naphthol (β-naphthol does not react) and a volume of strongest sulphuric acid equal to the entire liquid. If a plant fibre is present the liquid, on shaking, takes a deep violet colour. Animal fibre tinges the liquid a yellowish or reddish brown. If thymol is used in place of α-naphthol a scarlet-carmine colour appears. According to C. Leuken, menthol is preferable to thymol, giving a cherry-red colour.

Detection of Albumenoids in Wheat Grains.—F. Szymanski.—The grains are steeped for twelve to twenty-four hours in a moderately dilute solution of copper sulphate, freed from excess of liquid by means of blotting-paper, cut into sections, which are then laid in a drop of moderately dilute alkaline lye on the stage.

Micro-chemical Detection of Phloroglucine,—O. Lindt.—The author utilises the reaction produced by hydrochloric acid and vanilline with the phenols. If the liquid is very dilute only orcine and phloroglucine react, the former giving a light blue and the latter red turning to a violet.

Distinction between Purified and Natural Guiacum-Resin.—H. Hager.—This distinction is of some importance, since only the natural resin can be used as a reagent for ozone. 0·15 grm. of the ground resin is dissolved in 5 grms. of absolute alcohol and filtered in the dark. The liquid, with the addition of ten drops oil of turpentine, gives, if the resin has been purified, a dark mixture, turning blue in one or two minutes. The natural resin takes and retains for many hours a yellow colour.

Detection of Pure Castor Oil.—Finkener.

Determination of Mercury Chloride in Sublimate Soap.—O. Kaspar and E. Geissler.

Examination of Chloral Hydrate.—A. Kremel.

Examination of Balsams, Resins, and Gum-resins.—A. Kremel.—For these four papers we must refer to the original.

Detection of Hyposulphurous Acid in Urine.—E. Salkowski.—The author distils 100 c.c. of the urine with 10 c.c. of hydrochloric acid of sp. gr. 1·12 down to one-fourth of the original volume. The sulphur separated off is deposited in the upper part of the condenser.

Determination of Nitrogen in the Urine and the Milk of the Herbivora.—H. Weiske.—The methods of Varrentrapp-Will and of Kjeldahl yielded concordant results.

Determination of Urea with Sodium Hypobromite.—J. Marshall.—The author uses a modification of the apparatus of Greene.

Distinction between Chrysophanic Acid and the Colouring-Matter of Santonin in Urine.—G Hoppe-Seyler.—The urine is rendered alkaline with soda and shaken up with amylic alcohol. The colour of santonine passes into the alcohol, whilst chrysophanic acid does not.

The Luminosity of Phosphorus.—K. Polstorff and J. Mensching.—This phenomenon is suppressed by the presence of mercuric chloride and of phenol.

The Hæmidine Crystals of Dannenberg.—These crystals are merely sulphur.

Contributions to Forensic Chemistry.—G. Dragendorff.—Researches on the effects of medicines on different parts of the body, as found on *post mortem* examinations.

The Atomic Weight of Germanium.—A. Winkler.—The author obtains the mean value 72·32, which agrees very closely with the figure predicted by Mendeleeff, *i.e.*, about 72.

Recalculation of the Results of the Determinations of Stas.—J. D. Van der Plaats.—The author finds that silver, as obtained by the method of Stas, contains no oxygen, and that consequently the objections of Dumas against the atomic weights as determined by Stas are unfounded.

MISCELLANEOUS.

Dr. Carnelley's Gift of a Museum to University College, Dundee.—Mr. D'Arcy W. Thompson writes as follows to the *Dundee Advertiser*, of Jan. 24th:—"Your readers may recollect that some three months ago Dr. Forbes Watson, the well-known authority on Indian produce, offered his great collection of commercial products to the University of Anerdeen at the comparatively small price of £250. I begged Dr. Forbes Watson to make the same offer to us, in the remote event of its refusal by Aberdeen, and he agreed, telling me that he had hesitated whether to offer the collection in the first instance to Dundee, to whose staple trade very many of the samples are closely related. The Town Council of Aberdeen promised a subscription of £50 towards the purchase money, but, nevertheless, the University authorities, after three months' deliberation, found themselves unable to raise the sum, and regretfully declined the offer. On Thursday last Dr. Forbes Watson wrote me to this effect, and to make his promised offer to us. I discussed the matter with my colleague Dr. Carnelley. He left the same evening for London, and wrote me the next day that his father and he had purchased the collection to present it to our college. No help has ever been given this college so promptly or more judiciously. This excellent gift puts us at once in possession of a museum which is first-class of its kind, and of which town and college should be proud for ever. Dr. Forbes Watson is well-known to many of the older men in Dundee for his knowledge of jute and all other commercial fibres. His works are standard on the subject. His collection was amassed with unrivalled opportunities and the highest technical skill. Great part of it was brought together as an official duty for the Indian Museum, and was presented by the department to Dr. Forbes Watson when that museum was broken up. It contains nearly 7500 samples. Between 700 and 800 of these are fibres, including textiles and paper-making materials. There are over 500 dyes and dye stuffs, 500 oils and oil seeds, 600 or 700 gums, resins, and guttas, nearly 2000 medicinal substances (may they be useful to us in the future), and more than as many samples of food stuffs. The bulk of the collection is stored in bottles, filling fourteen cabinets, and there are also stands and cases for the display of specimens. Altogether the cases and bottles in which this great collection is stored represent a cost greater than the price which Dr. Forbes Watson now asks and receives. The opportunity was a golden one. But such opportunities are not so rare as are the wisdon and kindliness with which this one has been seized.

Method of Observing the Action of Magnets on Liquids.—S. T. Morehead.—Recently one of my students, Mr. J. C. Child, and myself were working with a diamagnetic instrument, simply repeating well known experiments. Plücker's method of observing the diamagnetism

of liquids having failed in our hands to give satisfactory results, we hit upon a method which was new to us and which was very satisfactory. Into a glass tube of about four or five millimetres internal diameter a small quantity of liquid was introduced forming a short cylinder. This this tube was placed horizontally at right angles to the line joining the poles of the magnet with the liquid nearly between the poles. When the current was turned on the liquid was very evidently repelled. Water was repelled through a distance of about half a centimetre; wood spirit through a greater distance. By moving the tube in the direction of its length the wood spirit could be pushed any distance through the tube. The amount of motion is of course a function of the resistances due to adhesion and friction as well as of the repulsive force. The attraction of liquids is easily shown by the same method. A single modification of the above plan of proceeding is to incline the tube slightly so as to make the liquid flow toward the poles. If the required velocity be not too great the magnet acts as a break to stop the motion. It is well to bend the tube up a little at each end to prevent the liquids from flowing out. This method is well adapted for projection so as to be seen by large audiences.—*American Journal of Science*, Vol. xxxiv., No. 201.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Healing Properties of Gold (Reply to Bertha Körter).—"The reason why gold wires are inserted into holes made in the ears is rather chemical than medical. Gold is not acted on by the fluids of the wounded part, and consequently irritant compounds which might prevent healing are not formed. . . . The notion of the healing nature of gold is simply an exploded notion. The gold has no active healing power, but it does not interfere with healing, as other metals through the chemical compounds formed."—*British Medical Journal*, Sept. 24, 1881, p. 544. Hoping this extract will set at rest Bertha Körter's question as to the healing properties of gold (see CHEMICAL NEWS, vol. lvi., p. 140).—MARY SHOONEN.

MEETINGS FOR THE WEEK.

MONDAY, 20th.—Medical, 8.30.
—— Society of Chemical Industry, 8. "The Bromine Absorption of Mineral Oils," by J. B. McArthur. "Note on Camphor Oil and Oil of Sunflower," by Mr. Kingzett. "On a New Series of Cotton Colouring-matters," by A. G. Green. "Note on Kjeldahl's Method of Nitrogen Determination," by Professor Meldola and E. H. Moritz.
—— Society of Arts, 8. "Yeast, its Morphology and Culture," by A. Gordon Salamon, F.C.S.

TUESDAY, 21st.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.

WEDNESDAY, 22nd.—Society of Arts, 8. "The Technical Education Bill," by Swire Smith.

THURSDAY, 23rd.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Telegraphic Engineers, 8.
—— Royal Institution 3. "Early Secular Choral Music," by Prof. Hubert H. Parry, M.A.

FRIDAY, 24th.—Quekett Club, 8. (Anniversary).
—— Society of Arts, 8. "Facts Regarding the Religions of India, and their Influences on the Social Progress of the People," by Sir William W. Hunter, K.C.S.I., C.I.E., LL.D.
—— Royal Institution 9. "Westminster Abbey," by The Very Rev. G. Granville Bradley, D.D., Dean of Westminster.

SATURDAY, 25th.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.
—— Physical, 3. "Note on the Efficiency of Incandescent Lamps with Direct and Alternate Currents," by Prof. W. Ayrton, F.R.S., and Prof. John Perry, F.R.S. "Observations on the Height and Length of Ocean Waves," by Hon. Ralph Abercrombie. "Experiments on Electrolysis," by W. W. Haldane Gee. "On the Temperature at which Nickel begins suddenly to Lose its Magnetic Properties," by Herbert Tomlinson.

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GAS DEPARTMENT.
The Gas Committee of the Corporation of BIRMINGHAM are prepared to receive Tenders for the Tar to be produced at their various Works from the 30th of June next, for a period of one or two years, or for one year and then subject to termination of the contract on three months' notice on either side.
The quantities to be dealt with in the year ending 30th June, 1889, are estimated as follows:—
Saltby Works, 9000 tons.
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Adderley St Works, 2400 tons.
Swan Village Works, 2550 tons.
The Committee will receive Tenders either at a fixed price per ton or at a varying price to be calculated on the actual returns obtained from time to time on the sale of the products derived from the Tar, provided that in such case the Contractor is dealing only with the Corporation Tar.
The Corporation will be willing to let on lease Land on which Tar Works could be erected, or they would erect Works on their own land and let them to the Contractor.
Forms and Conditions of Tender may be obtained on application to me,
EDWIN SMITH, Secretary.
Borough Gas Office, Council House,
Birmingham, December 31, 1887.

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THE CHEMICAL NEWS.

VOL. LVII. No. 1474.

ON THE RELATIVE DENSITIES OF HYDROGEN AND OXYGEN.

PRELIMINARY NOTICE.*

By Lord RAYLEIGH, Sec. R.S.,
Professor of Natural Philosophy in the Royal Institution.

THE appearance of Prof Cooke's important memoir upon the atomic weights of hydrogen and oxygen† induces me to communicate to the Royal Society a notice of the results that I have obtained with respect to the relative *densities* of these gases. My motive for undertaking this investigation, planned in 1882,‡ was the same as that which animated Prof. Cooke, namely, the desire to examine whether the relative atomic weights of the two bodies really deviated from the simple ratio 1 : 16, demanded by Prout's Law. For this purpose a knowledge of the densities is not of itself sufficient; but it appeared to me that the other factor involved, viz., the relative atomic *volumes* of the two gases, could be measured with great accuracy by eudiometric methods, and I was aware that Mr. Scott had in view a re-determination of this number, since in great part carried out.§ If both investigations are conducted with gases under the normal atmospheric conditions as to temperature and pressure, any small departures from the laws of Boyle and Charles will be practically without influence upon the final number representing the ratio of atomic weights.

In weighing the gas the procedure of Regnault was adopted, the working globe being compensated by a similar closed globe of the same external volume, made of the same kind of glass, and of nearly the same weight. In this way the weighings are rendered independent of the atmospheric conditions, and only small weights are required. The weight of the globe used in the experiments here to be described was about 200 grms., and the contents were about 1800 c.c.

The balance is by Oertling, and readings with successive releasements of the beam and pans, but without removal of the globes, usually agreed to 1 10th m.grm. Each recorded weighing is the mean of the results of several releasements.

The balance was situated in a cellar, where temperature was very constant, but at certain times the air currents, described by Prof. Cooke, were very plainly noticeable. The beam left swinging over night would be found still in motion when the weighings were commenced on the following morning. At other times these currents were absent, and the beam would settle down to almost absolute rest. This difference of behaviour was found to depend upon the distribution of temperature at various levels in the rooms. A delicate thermopile with reflecting cones was arranged so that one cone pointed towards the ceiling and the other to the floor. When the galvanometer indicated that the ceiling was the warmer, the balance behaved well, and *vice versâ*. The reason is, of course, that air is stable when the temperature increases upwards, and unstable when heat is communicated below. During the winter months the ground was usually warmer than the rest of the room, and air currents developed themselves in the weighing closet. During the summer the air cooled by contact with the ground remained as a layer below, and the balance was undisturbed.

The principal difference to be noted between my arrangements and those of Prof. Cooke is that in my case no desiccators were used within the weighing closet. The general air of the room was prevented from getting too damp by means of a large blanket, occasionally removed and dried before a fire.*

In Regnault's experiments the globe was filled with gas to the atmospheric pressure (determined by an independent barometer), and the temperature was maintained at zero by a bath of ice. The use of ice is no doubt to be recommended in the case of the heavier gases; but it involves a cleaning of the globe, and therefore diminishes somewhat the comparability of the weighings, vacuous and full, on which everything depends. Hydrogen is so light that, except perhaps in the mean of a long series, the error of weighing is likely to be more serious than the uncertainty of temperature. I have therefore contented myself with enclosing the body of the globe during the process of filling in a wooden box, into which passed the bulbs of two thermometers, reading to tenths of a degree centigrade. It seems probable that the mean of the readings represents the temperature of the gas to about 1 10th degree, or at any rate that the differences of temperature on various occasions and with various gases will be given to at least this degree of accuracy. Indeed the results obtained with oxygen exclude a greater uncertainty.

Under these conditions the alternate full and empty weighings can be effected with the minimum of interference with the surface of the globe. The stalk and tap were only touched with a glove, and the body of the globe was scarcely touched at all. To make the symmetry as complete as possible, the counterpoising globe was provided with a similar case, and was carried backwards and forwards between the balance room and the laboratory exactly as was necessary for the working globe.

In my earliest experiments (1885) hydrogen and oxygen were prepared simultaneously in a U-shaped voltameter containing dilute sulphuric acid. Since the same quantity of acid can be used indefinitely, I hoped in this way to eliminate all extraneous impurity, and to obtain hydrogen contaminated only by small quantities of oxygen, and *vice versa*. The final purification of the gases was to be effected by passing them through red-hot tubes, and subsequent desiccation with phosphoric anhydride. In a few trials I did not succeed in obtaining good hydrogen, a result which I was inclined to attribute to the inadequacy of a red heat to effect the combination of the small residue of oxygen.† Meeting this difficulty, I abandoned the method for a time, purposing to recur to it after I had obtained experience with the more usual methods of preparing the gases. In this part of the investigation my experience runs nearly parallel with that of Prof. Cooke. The difficulty of getting quit of the dissolved air when, as in the ordinary preparation of hydrogen, the acid is fed in slowly at the time of working, induced me to design an apparatus whose action can be suspended by breaking an external electrical contact. It may be regarded as a Smee cell thoroughly enclosed. Two points of difference may be noted between this apparatus and that of Prof. Cooke. In my manner of working it was necessary that the generator should stand an internal vacuum. To guard more thoroughly against the penetration of external air, every cemented joint was completely covered with vaseline, and the vaseline again with water. Again, the zincs were in the form of solid sheets, closely surrounding the platinised plate on which the hydrogen was liberated, and standing in mercury. It was found far better to work these cells

* A Paper read before the Royal Society, February 9th, 1888.

† "The Relative Values of the Atomic Weights of Hydrogen and Oxygen," by J. P. Cooke and T. W. Richards, *Amer. Acad. Proc.*, vol. xxiii., 1887.

‡ Address to Section A, British Association "Report," 1882.

§ "On the Composition of Water by Volume," by A. Scott, *Roy. Soc. Proc.*, June 16, 1887 (vol. xlii., p. 396).

* I can strongly recommend this method. In twenty-four hours the blanket will frequently absorb 2 lbs. of moisture.

† From Prof. Cooke's experience it appears not improbable that the impurity may have been sulphurous acid. Is it certain that in his combustions no hydrogen (towards the close largely diluted with nitrogen) escapes the action of the cupric oxide?

by their own electromotive force, without stimulation by an external battery. If the plates are close, and the contact wires thick, the evolution of gas may be made more rapid than is necessary or indeed desirable.

Tubes, closed by drowned stopcocks, are provided, in order to allow the acid to be renewed without breaking joints; but one charge is sufficient for a set of experiments (three to five fillings), and during the whole of the time occupied (ten to fourteen days) there is no access of atmospheric air. The removal of dissolved air (and other volatile impurity) proved, however, not to be so easy as had been expected, even when assisted by repeated exhaustions, with intermittent evolution of hydrogen; and the results often showed a progressive improvement in the hydrogen, even after a somewhat prolonged preliminary treatment. In subsequent experiments greater precautions will be taken.* Experience showed that good hydrogen could not thus be obtained from zinc and ordinary "pure" sulphuric acid, or phosphoric acid, without the aid of purifying agents. The best results so far have been from sulphuric and hydrochloric acid, when the gas is passed in succession over liquid potash, through powdered corrosive sublimate, and then through powdered caustic potash. All the joints of the purifying tubes are connected by fusion, and a tap separates the damp from the dry side of the apparatus. The latter includes a large and long tube charged with phosphoric anhydride, a cotton-wool filter, a blow-off tube sealed with mercury until the filling is completed, besides the globe itself and the Töppler pump. A detailed description is postponed until the experiments are complete. It may be sufficient to mention that there is but one india-rubber connexion, —that between the globe and the rest of the apparatus,— and that the leakage through this was usually measured by the Töppler before commencing a filling or an evacuation.

The object of giving a considerable capacity to the phosphoric tube was to provide against the danger of a too rapid passage of gas through the purifying tubes at the commencement of a filling. Suppose the gas to be blowing off, all the apparatus except the globe (and the Töppler) being at a pressure somewhat above the atmospheric. The tap between the damp and dry sides is then closed, and that into the globe is opened. The gas which now enters somewhat rapidly is thoroughly dry, having been in good contact with the phosphoric anhydride. In this way the pressure on the dry side is reduced to about 2 inches of mercury, but this residue is sufficient to allow the damp side of the apparatus to be exhausted to a still lower pressure before the tap between the two sides of the apparatus is re-opened. When this is done, the first movement of the gas is retrograde, and there is no danger at any stage of imperfect purification. The generator is then re-started until the gas (after from two to five hours) begins to blow off again.

In closing the globe some precaution is required to secure that the pressure therein shall really be that measured by the barometer. The mercury seal is at some distance from, and at a lower level than, the rest of the apparatus. After removal of the mercury the flow of gas is continued for about one minute, and then the tap between the dry and damp sides is closed. From three to five minutes more were usually allowed for the complete establishment of equilibrium before the tap of the globe was turned off. Experiments on oxygen appeared to show that two minutes was sufficient. For measuring the atmospheric pressure *two* standard mercury barometers were employed.

The evacuations were effected by the Töppler to at least $\frac{1}{100000}$, so that the residual gas (at any rate after one filling with hydrogen) could be neglected.

I will now give some examples of actual results. Those in the following tables relate to gas prepared from *sulphuric* acid, with subsequent purification, as already described:—

Globe (14), empty.

Date. 1887.	Left.	Right.	Balance reading.
Oct. 27 to Nov. 5 ..	G_{14}+0·394	G_{11}	22·66
Nov. 7 to Nov. 8 ..	—	—	22·89
Nov. 9 to Nov. 10 ..	—	—	23·00
Nov. 11 to Nov. 12 ..	—	—	21·72

Globe (14), full.

Date. 1887.	Left.	Right.	Balance reading.	Barometer. In.	Temperature. C.
Nov. 5 to 7..	G_{14}+0·2400	G_{11}	20·52	29·416	14·7°
Nov. 8 to 9..	G_{14}+0·2364	G_{11}	19·77	29·830	12·3°
Nov. 10 to 11..	G_{14}+0·2360	G_{11}	19·18	22·807	11·2°
Nov. 12 to 14..	G_{14}+0·2340	G_{11}	19·51	30·135	10·3°

The second column shows that globe (14) and certain platinum weights were suspended from the left end of the beam, and the third column that (in this series) only the counterpoising globe (11) was hung from the right end. The fourth column gives the mean balance reading in divisions of the scale, each of which (at the time of the above experiments) represented 0·000187 grm. The degree of agreement of these numbers in the first part of the table gives an idea of the errors due to the balance, and to uncertainties in the condition of the exteriors of the globes. A minute and unsystematic correction depending upon imperfect compensation of volumes (to the extent of about 2 c.c.) need not here be regarded.

The weight of the hydrogen at each filling is deduced, whenever possible, by comparison of the "full" reading with the mean of the immediately preceding and following "empty" readings. The difference interpreted in grms. is taken provisionally as the weight of the gas. Thus for the filling of Nov. 5:—

$$H = 0{\cdot}154 - 2{\cdot}25 \times 0{\cdot}000187 = 0{\cdot}15358.$$

The weights thus obtained depend of course upon the temperature and pressure at the time of filling. Reduced to correspond with a temperature of 12°, and to a barometric height of 30 inches (but without a minute correction for varying temperature of the mercury) they stand thus:—

November 5	0·15811
,, 8	0·15807
,, 10	0·15798
,, 12	0·15792
Mean	0·15802

The hydrogen obtained hitherto with similar apparatus and purifying tubes from hydrochloric acid is not quite so light, the mean of two accordant series being 0·15812.

The weighing of oxygen is of course a much easier operation than in the case of hydrogen. The gas was prepared from chlorate of potash, and from a mixture of the chlorates of potash and soda. The discrepancies between the individual weighings were no more than might fairly be attributed to thermometric and manometric errors. The result reduced so as to correspond in all respects with the numbers for hydrogen is 2·5186.*

But before these numbers can be compared with the object of obtaining the relative densities, a correction of some importance is required, which appears to have been overlooked by Professor Cooke, as it was by Regnault. The weight of the gas is *not* to be found by merely taking the difference of the full and empty weighings, unless indeed the weighings are conducted *in vacuo*. The external volume of the globe is larger when it is full than when it is empty, and the weight of the air corresponding to this difference of volume must be *added* to the apparent weight of the gas.

By filling the globe with carefully boiled water, it is not difficult to determine experimentally the expansion per

* Spectrum analysis appears to be incapable of indicating the presence of comparatively large quantities of nitrogen.

* An examination of the weights revealed no error worth taking into account at present.

atmosphere. In the case of globe (14) it appears that under normal atmospheric conditions the quantity to be added to the apparent weights of the hydrogen and oxygen is 0·00056 grm.

The actually observed alteration of volume (regard being had to the compressibility of water) agrees very nearly with an *d priori* estimate, founded upon the theory of thin spherical elastic shells and the known properties of glass. The proportional value of the required correction, in my case about $\frac{4}{10000}$ of the weight of the hydrogen, will be for spherical globes proportional to a/t where a is the radius of the globe, and t the thickness of the shell, or to V/W, if V be the contents and W the weight of the glass. This ratio is nearly the same for Professor Cooke's globe and for mine; but the much greater departure of his globe from the spherical form may increase the amount of the correction which ought to be introduced.

In the estimates now to be given, which must be regarded as provisional, the apparent weight of the hydrogen is taken at 0·15804, so that the real weight is 0·15860. The weight of the same volume of oxygen under the same conditions is 2·5186 + 0·0006 = 2·5192. The ratio of these numbers is 15·884.

The ratio of densities found by Regnault was 15·964, but the greater part of the difference may well be accounted for by the omission of the correction just now considered. In order to interpret our result as a ratio of atomic weights, we need to know accurately the ratio of atomic volumes. The number given as most probable by Mr. Scott in May, 1887,* was 1·994, but he informs me that more recent experiments under improved conditions give 1·9965. Combining this with the ratio of densities, we obtain as the ratio of atomic weights:—

$$\frac{2 \times 15{\cdot}884}{1{\cdot}9965} = 15{\cdot}912$$

It is not improbable that experiments conducted on the same lines, but with still greater precautions, may raise the final number by one or even two thousandths of its value.

The ratio obtained by Professor Cooke is 15·953; but the difference between this number and that above obtained may be more than accounted for, if I am right in my suggestion that his gas weighings require correction for the diminished bouyancy of the globe when the internal pressure is removed.

* *Loc. cit.*

ON THE

CONSTANCY IN THE HEAT PRODUCED BY THE REACTION OF CERTAIN SALTS ON EACH OTHER.

By SPENCER U. PICKERING.

THERE seems to be an adverse fate which prevents chemists from understanding the thermal phenomena of neutralisation. For the fourth time I beg to point out errors which have been made through a misunderstanding of these facts by authors of papers which have appeared in the CHEMICAL NEWS.

In a communication by T. W. Richards (lvii., 16), extracted from the *Proceedings of the American Academy of Arts and Sciences*, the author precipitates solutions of various metallic chlorides by a solution of silver nitrate, and finds that the heat evolved is a constant quantity, viz., 16,165 cals., and hence concludes that "the difference between the heats of formation of equivalent amounts of nitrates and chlorides in aqueous solution is the same for any metal or basic radical." Now this conclusion, though correct, is simply a consequence of the fact ascertained by Thomsen, that the heat of neutralisation of any alkali by hydrochloric or nitric acid is a constant quantity, independent of the nature of the base. These results may be expressed, as I have shown (*Chem. Soc. Trans.*, 1887, 594) by the equation—

$$M,Cl,Aq - M',Cl,Aq = M,(NO_3),Aq - M',(NO_3),Aq,$$

in which M and M' represent equivalents of any metallic radicles. Now, when we precipitate a metallic chloride (say KCl) in solution by silver nitrate, the actions taking place are—

Decomposition of KCl sol.; Decomposition of $AgNO_3$ sol.;
$- K,Cl,Aq$ $- Ag,NO_3,Aq$ $+$
Formation of KNO_3 sol.; Formation of AgCl ppt.;
$K,(NO_3),Aq$ $+$ Ag,Cl

and must give the same results as in the case of any other metallic chloride—

$$= -Na,Cl,Aq - Ag,(NO_3),Aq + Na,(NO_3),Aq + Ag,Cl$$

for the equation simplifies down into

$$-K,Cl,Aq + K,(NO_3),Aq - Na,Cl,Aq + Na,(NO_3),Aq,$$

which, from the results of neutralisation above quoted, = O.

The heat evolved in each experiment (16,165 cals.), is, in fact, merely the heat of precipitation of silver chloride, the separate determinations showing the somewhat large error of ± 160 cals. This will be evident from the following considerations:—

The heat of formation of a salt in solution, such as K,Cl,Aq, is given, as I have shown *loc. sup. cit.)*, by the equation $(K,Aq) + (HCl,Ag^*) + N$, in which N represents the heat of neutralisation of hydrochloric acid by potash, while the heat of formation of the same salt in the solid state is represented by this quantity, *minus* the heat of dissolution of the salt, D. Thus the equation—

$$-K,Cl,Aq - Ag,(NO_3),Aq + K,NO_3,Aq + Ag,Cl$$

becomes—

$$-[K,Aq + H,Cl,Aq + N_1] - [Ag,\dagger Aq + H,NO_3,Aq + N_2] + [K,Aq + K,(NO_3),Aq + N_3] + [Ag,Aq + H,Cl,Aq + N_4 - D] = 16{,}165 \text{ cals.}$$

N_1, N_2, N_3, and N_4 all being equal, this simplifies into—

$$-D = 16{,}165 \text{ cals.}$$

The same conclusions may be drawn by regarding the equation $-K,Cl,Aq$, &c., as a special instance of the general equation—

$$M,Cl,Aq - M',Cl,Aq = M,(NO_3),Aq - M',(NO_3),Aq,$$

Ag,Cl being, of course, equal to $Ag,Cl,Aq - D$.

Mr. Richards's experiments were followed by a similar investigation by I. W. Fay (CHEMICAL NEWS, lvii., p. 36), in which metallic sulphates were precipitated by a solution of barium chloride, and here the heat evolved in the reaction represents, as in Mr. Richards's experiments, the heat of precipitation of the insoluble salt—barium sulphate in this case. It is only, however, when dealing with dyad metals that the heat evolved represents this quantity, for in these cases only do the values of the heat of neutralisation cancel. There is a constant difference between the heat of neutralisation of an alkali by hydrochloric acid and sulphuric acid with dyad metals, or, in the above equation—

$$-N_1 - N_2 + N_3 + N_4 = O.$$

Where the chloride taken is that of a monad metal—

$$(N_3 - N_1) > (N_4 - N_2)$$

therefore the heat produced will be less‡ than the heat of precipitation of barium sulphate by the amount of the difference between these two quantities, whereas if the chloride be that of a pseudo-triad metal, then—

$$(N_3 - N_1) < (N_4 - N_2),$$

* The heat of dissolution of the acid in water was accidentally omitted in the communication referred to.

† The dissolution of silver in water is of course an hypothetical reaction, but since it occurs twice with opposite signs in the equation, this is immaterial.

‡ $(N_3 - N_1)$ is a negative quantity.

and the heat produced will be increased by the difference between these two quantities (see Pickering, *Chem. Soc. Trans.*, 1887, 598). This explains the want of constancy observed by Mr. Fay in the various cases.

The fact that there is a constant difference in the heats of neutralisation by sulphuric and hydrochloric acids in the case of dyad metals only is probably due, as I have already suggested, to the exercise of residual affinity between the two metallic atoms present in the sulphate molecules in other cases.

It is interesting to compare Mr. Fay's results with those obtained by Thomsen. The third column in the accompanying table gives Thomsen's numbers obtained in the direct precipitation of the sulphate by barium chloride, as in Mr. Fay's experiments; from these results, in the case of the dyad metals Mg, Mn, Co, Cd, Zn, and Cu, Thomsen deduces the value for the precipitation of barium sulphate to be 5580 cals., and this quantity + the differences in the heat of neutralisation—

$$[(N_3 - N_1) - (N_4 - N_2)],$$

gives the indirect values in the cases of other metals, as quoted in the second column. With ferric sulphate only is there any very great difference between Thomsen's and Mr. Fay's results.

Precipitation of Sulphates by Barium Chloride.

	Thomsen.		Fay.
M	Indirect.	Direct.	Direct.
H_2	9120	—	9904
Na_2	5230	5240	5180
K_2	5330	5280	5594
Li_2..	5530	—	—
Tl_2..	5510	—	—
Am_2.	5510	5408	5556
Sr	6040	—	—
Ca	5880	—	—
Mg	—	5600	5556
Mn	—	5600	—
Co	—	5688	5736
Ni	—	—	5736
Fe	—	—	5817
Cd	—	5683	5776
Zn	—	5504	5556
Cu	—	5616	5534
$\frac{1}{3}Be_2$.	—	6660	—
$\frac{1}{3}Fe_2$.	—	9144	6864
$\frac{1}{3}La_2$.	—	6671	—
$\frac{1}{3}Al_2$.	—	—	6504
$\frac{1}{3}Ce_2$.	—	7254	—
$\frac{1}{3}Di_2$.	—	7380	—
$\frac{1}{3}Y_2$	—	7614	—
$\frac{1}{4}K_2Al_2$	—	6407	6624
$\frac{1}{4}K_2Cr_2$	—	6136	6324
$\frac{1}{4}Am_2Fe_2$. ..	—	—	8280

EXAMINATION OF A QUARTZ CONGLOMERATE FROM WITWATERSRAND (TRANSVAAL).

By PHILIP HOLLAND.

The Witwatersrand (the ridge or hill of white waters), so called from the clear pellucid character of the streams that flow from it, is the name given in the Transvaal to a tract of undulating country standing 6000 feet above the sea. The chief town of the district, Johannesberg, lies some 40 miles to the south of Pretoria.

Gold was found in the "Rand" by Mr. Struben in the spring of 1886, and the district was proclaimed a public gold-field in the autumn of the same year.

The Witwatersrand has of late attracted considerable attention, an attention doubtless justified by the richness of the reefs, their extent, and the facility with which the gold-bearing material can be quarried. Much of this consists of a loose quartz conglomerate, easy to win by pick and spade, though in many places the deposit presents the appearance of a compact quartzite. The reef crops out in certain localities, but for the most part lies 2 feet or so below the present surface. The colour varies between a light yellow and a dark reddish brown. Some kinds incline to a purplish brown. A specimen which I owe to the courtesy of Mr. Henry de Stedingk is one of the darker varieties. When received, a few of the smaller pebbles were found still imbedded in the siliceous matrix. The larger pebbles had doubtless become separated in transit. The appearance the sample presented on arrival was that of a mixture of rounded, water-worn, quartz pebbles, with angular fragments of quartzose sandstone, the quartz grains composing the latter being for the most part of the size of a millet seed, a smaller proportion being of larger size; the remainder of the sample, representing nearly 50 per cent of the whole, consisted of coarse gravelly sand. On washing a small quantity of the sand by elutriation it was easy to distinguish minute flakes of mica. I collected a few by the aid of a pipette, and on treating them with HF a solution was obtained that gave the spectroscopic reaction for potash well.

On treating a portion of the original sample in the same manner, and separating the iron and alumina oxides by ammonia, the spectrum of lithia was faintly visible.

The original sample did not contain "visible gold" in the sense in which this term is popularly understood, though, whilst washing some of the gravelly sand in the way described, there appeared now and again a glistening particle suggestive of gold.

The weight of the sample of reef deposit when received was 9 lbs., of which 4 lbs. 10 ozs. readily passed through a ¼-inch mesh. It may be useful to give the weights of a few pebbles and fragments of sandstone that failed to pass the mesh. The largest stone in the sample, a sandstone fragment, weighed 41·33 grms.; the next in size, a quartz pebble, 35·14 grms.; the mean weight for one of twelve smaller stones, apparently alike in size, was 31·7 grms.; taking fifty, still smaller, the weight of one was 14·4 grms.; taking again fifty stones, apparently half the size of the last, the weight of one stone was 8·7 grms. These figures may serve to give some idea of the coarseness of the matter composing the conglomerate. On completion of the weighings the whole sample was re-united, mixed as uniformly as was practicable, and then divided in two portions, A and B. In A, which was all reduced to fine powder, the gold was extracted by the wet method on quantities of from 1 to 1¼ lbs. A qualitative analysis was also made on this portion, special attention being directed to the detection of bismuth, the oxide of which was recently found by H. Louis in auriferous quartz from the Leydenburg district of the Transvaal. I did not, however, detect bismuth, nor in fact any of the less commonly occurring oxides, in my specimen of the Witwatersrand deposit.

To return to portion B of the divided sample: this was sifted, and all that passed the ¼-inch mesh was also reduced to powder and assayed for gold, precisely as A. Before, however, I set down the few assays made on my specimen of conglomerate, it will be instructive to give some figures obtained by Mr. Dawson, F.I.C., F.C.S., Analyst to the Government of the South African Republic. The figures are taken from the "Transvaal Almanac" of last year, published at Pretoria. The Editor of the Almanac remarks that—

"Mr. Dawson has favoured him with the average of between 400 and 500 trials of conglomerate from various reefs extending over the whole of the known Heidelberg Gold-fields. The average produce of the whole series of assays (including a test-crushing of 25 tons, which yielded 1 oz. 8 dwts. per ton) is equal to 3 ozs. 5 dwts. 12 grs. per ton. That includes very rich specimens, yielding over 5 ozs. per ton. As regards the percentage return, which will perhaps afford a better indication of the general run of ores, the statement is as follows:—

	Per cent.
Under 1 oz. per ton	48·9
,, 2 ozs. ,, ...	23·1
,, 3 ,, ,, ...	7·5
Above 3 ,, ,, ...	20·5

"It will thus be seen that nearly 50 per cent of the conglomerate at Witwatersrand yields less than 1 oz. per ton, whilst upwards of 20 per cent produces over 3 ozs. per ton."

The following are my assays of portion A, which show it to belong to the poorer descriptions of ore :—

Gold per ton.

Dwts.	Grs.
15	3
15	20
15	6½

The sifted material from the reserved portion B of the original sample yielded per ton—

Ozs.	Dwts.	Grs.
1	3	1·$\frac{3}{10}$
1	2	16

I regret my inability to give a larger number of tests of this interesting deposit; but they are useful in that they confirm a current statement regarding the Witwatersrand conglomerate, viz., that the gold is found principally in the matrix or cement that binds the pebbles together, though not confined to it entirely.

An analysis of the sifted material was made to show its general composition :—

SiO_2	85·720
Al_2O_3	4·270
Fe_2O_3	6·180
TiO_2	0·115
MnO	0·025
CaO	0·010
MgO	trace
K_2O	0·227
Na_2O	0·318
Organic matter	0·290
Water	2·560
	99·715

The alkalies, I presume, may be set down to the mica. The organic matter will be traceable doubtless to partially decayed vegetable fibres and humic substances.

RIDSDALE'S SIMPLIFIED CHROMOMETER FOR MODERATELY DEEP TINTS.

At the meeting of the Newcastle Section of the Society of Chemical Industry, February 7th, 1888, Mr. C. H. Ridsdale, F.I.C., F.C.S., read a short paper on the above apparatus.

It is for the rapid comparison of solutions of various depths of tint with a standard solution of similar tint, with a view to determining the quantity of the particular constituent present.

Hence it can be used for any chromometric method, —such as the estimation of *carbon* in all classes of steel; *copper* in wrought-iron, pig-iron, steel, ferro-manganese, iron ores, &c.; *manganese* in steel; *ammonia* in water, &c.

It consists of three glass tubes of equal bore, graduated, and perforated at the bottom, the hole being covered by a disc of opal glass.

Over these tubes slide three others, which can be held in the required position by a special form of grip. The columns of liquid to be compared are adjusted to any desired weight by raising or lowering these outer tubes.

METHOD FOR THE ANALYSIS OF CATTLE FOODS.*

Hygroscopic Moisture.—Dry 2 to 3 grms. at 100° C. to constant weight.

Ash.—Char the substance at a low red heat, exhaust the charred mass with water, burn the insoluble residue, add the ash to the residue from the evaporation of the aqueous extract obtained above, dry the whole at 110°, and weigh. Determine carbonic acid and insoluble matter (sand and charcoal) in the product for the estimation of the pure ash.

Ether Extract.—Pulverise the air-dry substance till all of it will pass through a sieve with not less than $\frac{1}{60}$ inch mesh; dry about 5 grms. at 100°, and take about 2 grms. for each extraction. Exhaust with anhydrous ether of specific gravity 0·720—0·725, not less than eight hours continuously. Dry ether extract at 100° in a current of dry hydrogen to a constant weight.

Crude Protein.—Determine nitrogen by the Kjeldahl method in the manner recommended by the Nitrogen Committee, and multiply the result by 6·25 for the crude protein.

Albumenoid Nitrogen, Stutzer's Method.—Prepare cupric hydrate as follows:—Dissolve 100 grms. of pure cupric sulphate in 5 litres of water, and add 2·5 c.c. of glycerin; add dilute solution of sodium hydrate till the liquid is alkaline, filter, rub the precipitate up with water containing 5 c.c. of glycerin per litre, and then wash by decantation or filtration till the washings are no longer alkaline. Then rub the precipitate up again in a mortar with water containing 10 per cent of glycerin, thus preparing a uniform gelatinous mass that can be measured out with a pipette. Determine the quantity of cupric hydrate per 1 c.c. of this mixture.

To 1 grm. of the substance, pulverised as for the determination of the ether extract, add 100 c.c. of water in a beaker, heat to boiling, or in case of substances rich in starch heat on the water-bath ten minutes, add a quantity of the cupric hydrate mixture containing 0·7 to 0·8 grm. of the hydrate, stir thoroughly, filter when cold, wash with cold water, and without drying put the filter and its contents into the concentrated sulphuric acid for the determination of the nitrogen after Kjeldahl. For filtering use either Schleicher and Schull's No. 589 filter-paper or Swedish paper, either of which contains so little nitrogen that it can be left out of account.

If the substance examined consists of seed of any kind or residues of seeds, such as oil cake or anything rich in alkaline phosphate, add a few c.c. of a concentrated solution of alum just before adding the cupric hydrate, and mix well by stirring. This serves to decompose the alkaline phosphate, precipitating aluminum phosphate; if this is not done cupric phosphate and pure alkali may be formed, and the protein copper may be partially dissolved in this alkaline liquid.

Crude Fibre, Weende Method.—Pulverise as for the ether extract, and extract the fat, at least nearly completely. To 2 grms. of the substance in an Erlenmeyer flask add 200 c.c. of boiling 1·25 per cent sulphuric acid, boil immediately and for thirty minutes continuously with as much rotary motion as may be necessary to keep all the substances that may tend to adhere to the sides of the flask in contact with the liquid, throw on a filter of finest linen, and rinse the flask and wash the contents of the filter thoroughly with boiling water. Wash the contents of the filter back into the flask with 200 c.c. of a 1·25 per cent solution of sodium hydrate, at once raise to boiling, and boil continuously for thirty minutes with rotary motion as above described, filter through a Gooch crucible or according to some similar device, and wash very thoroughly with boiling water. Such thorough

* Official Methods of Analysis of the Association of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

washing has been found to be essential to success. Wash then with alcohol and finally with ether, dry at 110°, weigh, incinerate, and give the loss of weight for crude fibre.

*Crude Fibre Closed Digestion Method.**—Pulverise as for the ether extract, and extract the fat at least nearly completely from 2 grms. of substance; allow the ether to evaporate, and transfer to a patent-stoppered beer-bottle with the aid of a funnel and 200 c.c. of a solution of 4 per cent hydrochloric acid in a wash bottle. Cork, and after seeing that the material is thoroughly saturated with the acid, with none floating on the surface, place in a bath of boiling water of such a size that the neck of the bottle being covered with a copper ring with a suitable-sized hole the entire bottle, except the upper part of the neck, will be surrounded by the boiling water or steam. At intervals of five minutes the bottle is grasped about the neck with a cloth and given such a rotary motion as to stir up the entire contents and wash down the neck. This is preferable to ordinary shaking. The digestion is continued for one hour and the acid then removed by filtration on finest washed linen, as in the preceding method, and the residue washed back with a wash-bottle into the bottle with 200 c.c. of 4 per cent solution of *sodic* hydrate, such as the granulated of the Greenbank Alkali Works. The digestion is then continued as before for one hour and the residue collected, as in the preceding method, and thoroughly washed with hot water, alcohol, and ether. It is dried at 110°, weighed, ignited at as low a heat as possible to prevent volatilisation of any soda salts which may not have been removed, and the crude fibre calculated from the loss.

Statement of Results.

	In the substance in its natural condition (or as received).	In the dry substance.
Moisture		
Ash		
Ether Extract		
Crude Fibre		
Crude Protein		
Nitrogen : Total		
Albumenoid ..		

PRELIMINARY NOTES.

By ARTHUR MICHAEL.

The approaching close of laboratory work for the present college year finds myself and co-workers with a number of unfinished investigations. It was thought advisable to state briefly the principal results that we have obtained, before the publication of the papers in full.

I. About five years ago Bischoff and Emmert† examined the action of bromine on propenyl-tricarboxylic acid, and obtained, besides other compounds, a dibrompyrotartaric acid that is isomeric with the three acids obtained by addition of bromine to ita-, citra-, and mesaconic acids. The discoverers do not attempt to give a constitutional formula to this interesting acid; but, keeping the behaviour of malonic acid and its derivatives towards bromine in mind, there can be no doubt that the reaction is represented by the following equation :—

$$\begin{array}{l} CH_3—CH—COOH \\ \quad | \\ CH<\begin{matrix}COOH \\ COOH\end{matrix} \end{array} + 2Br_2 = \begin{array}{l} CH_3—CH—COOH \\ \quad | \\ CBr_2—COOH. \end{array}$$

This interpretation is corroborated by the fact that α-bromcrotonic acid was found among the products of the reaction :—‡

$$\begin{array}{l} CH_3—CH—COOH \\ \quad | \\ CBr_2—COOH \end{array} = CH_3—CH—CBr—COOH + HBr + CO_2.$$

This explanation of the reaction made it very probable that the third possible dibromsuccinic acid would be obtained by the action of bromine on ethenyl-tricarboxylic acid :—

$$\begin{array}{l} CH—(COOH)_2 \\ | \\ CH_2—COOH \end{array} + 2Br_2 = \begin{array}{l} CBr_2—COOH \\ | \\ CH_2—COOH \end{array} + CO_2 + 2HBr.$$

I have made a number of experiments by heating bromine and the acid in a sealed tube at 100°, and have obtained a dibromsuccinic acid which in its properties very closely resembles the symmetrical dibromsuccinic acid obtained by addition of bromine to maleic acid. However, it is extremely probable that the unsymmetrical acid would pass over into the symmetrical compound when exposed to the conditions of the experiment, and I shall repeat the experiments except that the substances will be allowed to act in the cold, which were the conditions that gave the unsymmetrical dibrompyrotartaric acid.

II. It is customary in examining the reactions of guanidine to use the carbonate, but I have found that an alcoholic solution of guanidine sulphocyanate and sodium ethylate acts as free guanidine, and gives the reactions in a much more satisfactory manner. Thus, by treating this solution in the cold with phenyl-mustard oil or benzile, the compounds described by Bamberger* and Wense† are obtained in almost theoretical yield. The solution gives reactions that cannot be realised with the carbonate. As an instance, it unites with phthalic anhydride to form the compound—

$$C_6H_4<\begin{matrix}COOH & —NH_2 \\ CO—NH—C—NH\end{matrix}$$

which crystallises in large prisms and melts at 202°. Of greater interest is the action of cyanogen on the solution. Two compounds are formed in the reaction, one crystallising in long needles, and the other in indistinct yellow crystals that are somewhat soluble in water, giving the solution a beautiful fluorescence that is very nearly like that caused by resocyanine. The formula of this substance is $(C_1N_1O_1H_2)_x$, but it is evidently of very complicated composition. ‡

III. With Mr. G. M. Browne, the reactions of guanidine have been further studied. Benzoic ether and an alcoholic solution of guanidine sulphocyanate with sodium ethylate (1 mol. salt to two mols. $NaOC_2H_5$) gives no less than four distinct crystalline products. The reaction is very complicated and its study not yet completed. Guanidine sulphocyanate, sodium ethylate, and malonic ether give a substance crystallising in plates with both acid and basic properties. It has the constitution—

$$NH=C<\begin{matrix}NH—CO \\ NH—CO\end{matrix}>CH_2 + H_2O.$$

A. Pinner§ obtained a condensation product by the action of acetacetic ether on benzenyl-amidine, but was unsuccessful in a similar experiment with malonic ether. Such a product is obtained if an alcoholic solution of sodium malonic ether is used, and the reaction gives results with other bibasic ethers, as oxalic ether, sodium ethyloxide, and the amidine also give a condensation product.

IV. We have also continued our investigation on the isomerism of unsaturated acids. On treating solid crotonic acid, dissolved in carbon bisulphide, with chlorine at a

* Described by Clifford Richardson.
† *Berichte*, xv., 1107.
‡ *Ibid.* xiv., 626.

* *Berichte der Deutschen Chemischen Gesellschaft*, xiii., 1580.
† *Ibid*, xix., 761.
‡ While working with cyanogen it occurred to me to see whether it would react on alcoholic solutions of sodium acetacetic and sodium malonic ethers, as these substances behave like hases towards many reagents. (*American Chemical Journal*, ix., 124.) I found that a reaction takes place with great readiness, forming crystalline salts. It is my intention to have the reaction further examined.
§ *Berichte der Deutschen Chemischen Gesellschaft*, xviii., 763

low temperature, $\alpha\beta$-dichlorbutyric acid was obtained. This acid crystallises in prisms that melt at 63°. By treating the acid with alcoholic soda a fourth chlorcrotonic acid is formed, which crystallises in needles and melts at 67°. The acid differs in its properties and in its salts from the three previously known chlorcrotonic acids; and, as is evident from our previous work,* has the constitution $CH_3—CH—CCl—COOH$. It is the alpha-derivative of allocrotonic (isocrotonic) acid. We also made the observation that $\alpha\beta$-dichlorbutyric ether gives α-chlorcrotonic acid (97°) when treated with alkalies, which, in view of the fact that the free acid gives the allo-alpha-chlorcrotonic acid, is an interesting result.

V. With E. A. de Schweinitz, the action of sodium ethylate on mixtures of amides and ethers was continued. We find that urea, carbonic ether, and sodium ethylate give allophanic ether. From succinic ether, instead of carbonic, the compound—

$$\begin{array}{l} CH_2—CO—NNa—CONH_2 \\ | \\ CH_2—CO—NNa—CONH_2 \end{array}$$

was obtained. Urea sodium ethylate and benzile give—

$$\begin{array}{l} \qquad\quad N—CONH_2 \\ \qquad\quad \| \\ C_6H_5—CO—C—C_6H_5, \end{array}$$

and from acetamide with oxalic ether, acetyloxamic acid was obtained. Organic ethers do not react on compounds as weakly basic as metanitraniline, but a reaction takes place if sodium ethyloxide is present; with oxalic ether the compound $\begin{array}{l} CO—NHC_6H_4NO_2 \\ | \\ COOC_2H_5 \end{array}$ was obtained.

—*American Chemical Journal*, Vol. ix., No. 3.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir, — I do not know whether your correspondent, "F.I.C." (Chemical News, vol. lvii., p. 61), thinks that the more liberal scheme for admittance of Associates, which I propose to bring before the first meeting of the new Council, will tend to lower the standard of education required. I should like to be allowed to say that the opposite of this would be the tendency under the more liberal scheme. What we propose is, that it shall not be necessary for the Fellows of the Institute to be recruited from one or other of twenty different schools or colleges in the United Kingdom.—I am, &c.,

William Thomson.

Royal Institution Laboratory,
Manchester, February 15, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—The scheme which Mr. Thomson intends bringing forward at the next meeting of the new Council of the Institute of Chemistry will, I am sure, meet a want.

There are, no doubt, others who like myself studied Chemistry years ago, but who from various causes have been unable to join the Institute, and will—if compelled to study only at certain specified institutions—be probably precluded from doing so.

I went through a two years' course of theoretical and practical chemistry some ten years ago, and have since passed most of my time abroad, where I had few facilities for keeping abreast of what was going on in the chemical world at home.

After my return to England, some months ago, I communicated with the Institute to know whether, if I brushed up my knowledge of Chemistry *how and when I could*, they would be willing to subject me to the prescribed examinations.

My application was to be submitted to the Council, but in the meantime the regulations dispensing with examinations were published, and I applied for admission under them.

In reply the Secretary informed me that I was not a fit person to be admitted without examination; but as yet I have had no communication with regard to my original application.—I am, &c.,

F.C.S. since 1883.

London, February 14, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—On Thursday night last I received a circular, signed W. Thomson, stating that "a number of Fellows of the Institute have now agreed upon an expression of their views at the forthcoming ballot, in the manner presently to be mentioned."

The circular then proceeds to allege the existence of a "widespread feeling of dissatisfaction" as to the recent management of the Institute.

This is followed up by a general statement that the Council is too much composed of mere Professors and Teachers of Chemistry, for whom it is asserted the Institute was "*not in any way designed or required.*" The italics are mine.

The main body of the circular, containing the gist of the whole, is, however, devoted to a general complaint that the private pupils of analytical and consulting chemists are not placed, as regards admission as Associates, in the same position as those men who have passed three years in one or other of some specified schools or colleges.

To show their objection to this regulation the "number of Fellows" on whose behalf Mr. W. Thomson writes, propose that a clean sweep of eight of the officially nominated candidates for Council shall be made in favour of another list which the "number of Fellows" consider to be less professorial and teacher-like.

Mr. Thomson is careful not to let us know the names of, or assign a value to, the "number" of Fellows whom he represents; hence one is somewhat in the dark as to the true width of the widespread feelings; but they are evidently people of profound depth, for their list proves them to have been able to decide that Dr. C. R. A. Wright is less professorial than Dr. F. R. Japp, and that Mr. B. E. R. Newlands is so much more of a Professor than his brother Mr. J. A. R. Newlands, that the satisfaction of the widespread feeling demands the substitution of the latter gentleman's name for that of the former.

It is somewhat surprising, after reading the circular, to turn to the list of candidates for office proposed by the retiring Council, and to find there—(1) That the president is an analytical and consulting chemist; (2) that at least two vice-presidents belong to the same class; (3) that the treasurer is a chemical manufacturer; (4) that about seventeen out of the twenty-seven names on the council are those of analytical and consulting chemists, Mr. W. Thomson's being amongst them. Surely the most exacting analyst should be satisfied with a preponderance of this amount.

As one of the original Council, and one who had some small share in the movement which brought about the foundation of the Institute, I must enter my earnest protest against Mr. W. Thomson's attempt to caucus and capture the Council of that body. I had hoped that an

* *Berichte der Deutschen Chenischen Gesellschaft*, xix., 1378, 1386 xx., 550. *Jour. Prakt. Chemie* [2], xxxv., 257.

nterval of eleven years had permitted the jealousies which rendered chemists a divided and a helpless body to die out. We owe the Institute and its Charter to the help of the Professors of Chemistry; they have more leisure than most of us, and have not grudged it in working for the consolidation of the profession into a homogeneous whole.

I entirely traverse and deny Mr. Thomson's assertions as to the Institute not being intended for or needed by professors and teachers. The Institute was for the whole profession, and not for any class or clique. The present Council is a fair and representative body, and so is the proposed one. If an organised attack is made, as now proposed, ill feelings will be aroused all round and numerous secessions will take place.

There was a constitutional means, open to Mr. Thomson and his friends, by which they could nominate or obtain the nomination of more analysts, yet it is said that only one such form was received by the Council.

I hope that the mass of members will vote for the list as issued by the Council, and so continue the necessary work of conciliation and comprehension, thus preserving us from seeing the Institute made into a purely party trades' union, and another example of that spirit which animated him

> "Who, made for the Universe, narrowed his mind,
> And to Party gave up what was meant for Mankind.'

—I am, &c.,

R. J. Friswell.

115, Darenth Road, N., February 18, 1888.

[We have good reasons for knowing that Mr. W. Thomson stated at a meeting of the Council of the Institute of Chemistry that the circular above referred to, although purporting to be signed by him, had been issued without his authority.—*Ed.* C. N.]

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—With reference to a circular letter dated the 12th inst., and bearing the signature of Mr. W. Thomson, which has been sent to the Fellows of the Institute of Chemistry, we beg that you will be so good as to allow us to inform the Fellows, through your columns, that we have not been consulted in regard to the action taken by Mr. Thomson, and that we decline to offer ourselves as candidates for election in opposition to the nominations of the Council,—We are, &c.,

Boverton Redwood.
Alfred Gordon Salamon.

London, February 20, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I have received a circular relating to the Institute of Chemistry, dated the 14th inst., and issued from the Royal Institution, Manchester, in which my name has been inserted as a candidate for the Council of the Institute without my knowledge or consent.

Now although, in common with other Fellows of the Institute, I have long since expressed a qualified agreement with certain alterations in the mode of carrying out its objects, it need hardly be said that I in no way approve of the changes in the Council proposed by the Manchester circular, and I intend voting for the Balloting List as issued by the Council.

Having personally no desire or valid claim to be on the Council, should I by any chance be elected I would at once decline to serve and send in my resignation.—I am, &c.,

John A. R. Newlands.

27, Mincing Lane, London, E.C., February 20, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I shall be obliged if you will allow me, through your columns, to state that I was entirely unaware that my name was to be proposed, in opposition to the nomination of the Council of the Institute of Chemistry. I was not consulted in the matter at all.—I am &c.,

E. W. Voelcker.

11, Salisbury Square, Fleet Street, London, E.C., Feb. 21, 1888.

COLOUR OF BRICKS.

To the Editor of the Chemical News.

Sir,—Can the readers of the Chemical News give information on the connection between the chemical composition of clay and the colour of the bricks manufactured from it?

Muspratt's "Chemistry" gives a tabular outline of the analyses of clays and the corresponding colour of the bricks.

In this neighbourhood there is a brick-field in which there are three distinct kinds of clay, each of which produces red bricks, but in each case the bricks become grey when sprinkled with road-sand before baking. The road-sand is ground flint or impure silica and the bricks sometimes are red in the centre; the greyness is caused entirely by the sand.

The question to which an answer is wanted is—How does the sand alter the colour of the bricks?—I am, &c.

Piffard.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 5, January 30, 1888.

Researches on Ruthenium: Per-ruthenic Acid.—H. Debray and A. Joly.—The authors describe the preparation and purification of this acid. It melts at 25·5°, forming a deep orange-red liquid which solidifies very slowly. The solid product retains the vitreous state for a long time. It only crystallises well on sublimation. Its vapour density is 5·77. It dissolves slowly in water, but does not appear to form a definite hydrate. The solution, in the absence of chlorine and of hypochlorites, is stable for some time in the dark or in diffused light. It ultimately becomes turbid and deposits on the sides of the vessel a black coating which is a hydrated ruthenium sesquioxide.

On Cinchonigine.—E. Jungfleisch and E. Léger.—The composition of this new base, which is possibly identical with that isolated by MM. Caventon and Girard in their recent attempt to fix C_2O_2 upon cinchonine has the composition $C_{28}H_{22}N_2O_2$. It forms colourless prisms of high refractive power. It melts at 128° and is volatile distilling under reduced pressure. It is very sparingly soluble in ethylic, methylic, and amylic alcohol, chloroform, benzene, and acetone. It is less soluble in anhydrous ether. Its acid solutions are not fluorescent. Its solution in water blues red litmus, but it has no action upon phenolphthalein.

On Bases obtained from Liquids which have undergone the Alcoholic Fermentation.—E. Charles Morin.—The author has determined the composition of one of these bases, $C_7H_{10}N_2$. He has studied some of the reactions of this base, and finds that it gives a yellow

precipitate with potassium iodo-mercurate. This precipitate is at first voluminous, but it soon changes into large yellow needles, which are very characteristic. With mercuric chloride and with phosphotungstic acid it gives white precipitates and a yellow deposit with phosphomolybdic acid.

The Laws of Chemical Equilibrium.—H. Le Chatelier.—A mathematical paper, not susceptible of useful abstraction.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 3.

Iodometric Studies.—G. Topf.—A completion of the extensive treatise begun in Part 2 of the present volume.

Determination of Ammonia in Soils by the Azotometric Method.— Dr. Anton Baumann.— In a former memoir the author has shown that this method suffers from three serious defects. These errors he now explains in detail. He fully admits that in the determination of pure ammoniacal salts the azotometric method is at once expeditious and accurate. But for the analysis of soils it should be entirely rejected.

The Analysis of Explosives.—W. Hempel.— This paper is unintelligible without the accompanying illustration.

Reichert's Method of Butter Analysis.— H. B. Cornwall and Shippen Wallace. — From the "Report of the State Board of Health of New Jersey."

The Quantitative Determination of the Constituents of Milk.—R. Palm.—The author maintains that none of the published methods for the quantitative determination of the constituents of milk satisfies the present demands of science. The determination of fat in milk gives no accurate results, the fatty matter coming up invariably too large. The lactose is always given too high, since, after the removal of the albumen and caseine from the milk, the other proteines, especially hemi-albumose and milk-peptone, reduce Fehling's liquor exactly like milk sugar. Hence these proteines, according to the present method, is calculated as lactose. The total proteins, from the same reason, are given too low. The author recommends the determination of the albumenoids either with a solution of mercury oxide, according to Millon and Commaille, or by means of a solution of tannin. In the latter case the protein tannate is perfectly dried and then treated with a mixture of three parts by weight of ether to one part of absolute alcohol. This mixture extracts all the tannin.

Quantitative Determination of Mineral Oils in Saponifiable Fats of Animal or Vegetable Origin.—A. Gawalowski.—The author saponifies with an alcoholic solution of potassa (about 2 parts potassa to 10 parts of fat), boils off the bulk of the alcohol, adds a solution of calcium or sodium chloride, and then sodium dicarbonate until the alkaline reaction has about disappeared. The soap thus treated is quite insoluble in petroleum-ether, and the mineral oil dissolved out is entirely free from soap.

Double Aspirator.—Hugo Schiff and C. Marangoni.

Complete Titration-Apparatus for Determining Acid in Distiller's Mashes.—F. Larssen.

Apparatus for the Volumetric Determination of Carbonic Acid in Carbonates.— D. Sidersky.— These three papers all require the accompanying illustrations,

Convenient Method of Generating Pure (Non-arsenical) Sulphuretted Hydrogen.—Dr. R. Fresenius. —Four parts of calcium sulphide are well ground up with one part of burnt calcium sulphate, water is added enough to form a very thick paste, which is then placed in flat quadrangular capsules, levelled down with a porcelain pestle, and allowed to set. The discs, taken out of the capsules, and about 15 m.m. in thickness, are cut up whilst still moist in cubes and dried at a gentle heat. For use the matter is placed in a Kipp gas generator and treated with dilute hydrochloric acid (1 vol. acid at sp. gr. 1·12 and 1 vol. water). The sulphuretted hydrogen is given off easily and steadily.

Micro-chemical Analysis.— T. H. Behrens.— From *Receuil des Travaux Chimiques des Pays-Bas* and Chemical News.

Determination of the Specific Gravity of Liquids. —C. Bohn.—The author utilises the principle of measuring the heights of columns of liquids which exert an equal pressure.

Determination of Melting-points.—C. F. Roth.— The author has proposed an apparatus which furnishes at at once corrected values, *i.e.*, values in which it is considered that for accurate determinations the total thread of mercury must be heated to the temperature of the melting substance. The apparatus is a modification of that of Anschütz and Schulz.

The Application of Steam in Chemical Laboratories.—R Galloway and J. O'Farrel.—From the *Philosophical Magazine*.

Apparatus for Determining Carbonic Acid in Carbonates.—R. Baur.—An unimportant modification of an instrument previously described in the *Zeitschrift* (xxiii., p. 371).

Apparatus for Determining Tensions.—G. W. A. Kahlbaum.

New Mercurial Air-pump.—Greiner and Friedrichs. —These two papers are merely mentioned.

Thermo-regulators.—G. H. Bailey.—From the Chemical News.

Special Forms of Condensers.—J. Walter, Shenstone, Kreusler, Wollny, and C. B. Gibson.— Modifications of apparatus formerly described in the *Zeitschrift* and a novel device from the *Analyst*.

Gas-Generator.—A. Gawalowski.—In this apparatus, unlike that of Kipp, the acid is completely utilised. Much more attention is required.

Exsiccator Tube for Boats.—A. Gawalowski.—This device cannot be intelligibly described without the accompanying illustration.

Improved Filter Stand.— Carl Simon (*Chemiker Zeitung*).—The funnels are supported in a porcelain arm having three ribs projecting inwards.

New Burette Stand. — L. Weinstein (*Chemiker Zeitung*).—A description of this apparatus would be of little utility.

The Use of Normal Ammonia Liquids.—R. Hempel. —The author particularly recommends a semi-normal ammonia liquid.

Original Standard for Volumetry.—R. Ullbricht and E. Meissl. — The authors recommend potassium tetroxalate, which is neither efflorescent nor hygroscopic, and is easily obtained in a state of purity. They prepare a hot saturated solution of neutral potassium oxalate and add the calculated quantity of a hot saturated solution of oxalic acid. On cooling the tetra-oxalate crystallises out and can be obtained perfectly pure by repeated crystallisation from hot water, cooling rapidly. If the liquid is stirred whilst cooling we obtain small crystals free from mother-liquor. The salt is then dried by exposure on blotting-paper. It serves not merely for the standard in acidimetric and alkalimetric determinations, but also for permanganate solutions.

Recovery of Molybdenum Residues.—W. Venator (*Chemiker Zeitung*).—The author tests first if the residues contain iron, and adds, if needful, ferric chloride until the liquid has a brownish yellow colour. For separating out the phosphoric acid he adds ammonia, when all the phosphoric acid is precipitated as iron phosphate along with excess of iron and a part of the magnesia. The pre-

cipitate is filtered off and the filtrate mixed with barium chloride, when the molybdic acid and any sulphuric acid present are precipitated as barium salts. The precipitate is well washed with hot water, dried, and digested with the suitable quantity of ammonium sulphate. The barium sulphate is filtered off and the ammonium sulphate separated by crystallisation from the ammonium molybdate. Residues containing much ammonium citrate (Wagner's method) interfere with the methods for recovery, and should not be mixed with other molybdic residues.

Thickened Filter-paper.— E. E. H. Francis.— From the *Journal of the Chemical Society*.

Generating Chlorine Gas. — C. Winckler. — The author makes small cubes of a mixture of chloride of lime and burnt calcium sulphate, and treats them in a Kipp apparatus with hydrochloric acid at sp. gr. 1·124, mixed with an equal volume of water. No sulphuric acid must be present.

Separation of Soda and Potassa from Lithia by treating the Chlorides with Amylic Alcohol, and a Similar Separation of the Same Alkalies from Magnesia and Lime.—F. A. Gooch.—From *Proceedings of American Academy of Arts and Sciences*.

On Germanium, its Detection and Determination. —Clemens Winckler.—Noticed under *Journal fur Praktische Chemie*.

Determination of Boric Acid.—F. A. Gooch.—From *Proceedings of American Academy of Arts and Sciences*.

Sugar obtained from Agar-Agar.—R. W. Bauer.— The author furnishes further proof of the non-identity of arabinose and lactose. Agar-agar contains a carbohydrate not yet isolated, but nearly related to Muntz's galaktin. On boiling with dilute acids it passes into lactose.

Two New Reactions for Sugar.—Hans Molisch.— Already noticed.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Vinegar-Making Apparatus.—Does any correspondent know of a vinegar-making apparatus, capable of making a medium vinegar in twelve to fourteen days? It is desired to make 300 or 400 gallons in this time.—W.

MEETINGS FOR THE WEEK.

Monday, 27th.—Medical, 8.30.
—— Society of Arts, 8. "The Modern Microscope," by John Mayall, Jun.
Tuesday, 28th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
Wednesday, 29th.—Society of Arts, 8. Discussion on Mr. Swire Smith's paper, "The Technical Education Bill."
—— Geological, 8,
Thursday, March 1st.—Royal, 4.30.
—— Royal Institution 3. "Early Secular Choral Music," by Prof. Hubert H. Parry, M.A.
—— Parkes Museum, 5. "Milk and Disease," by G. Sims Woodhead, M.D. (Edin.), F.R.S.E.
—— Chemical, 8. "The Origin of Colour and the Constitution of Colouring-matter generally," by H. E. Armstrong, F.R.S.
Friday, 2nd.—Geologists' Association, 8.
—— Royal Institution, 9. "Poisons and Poisoning," by C. Meymott Tidy, M.B., F.C.S.
Saturday, 3rd.—Royal Institution, 3. "Experimental Optics," by the Right Hon. Lord Rayleigh.

Errata.—P. 64, col. i., line 30 from top, *for* "Gumdagai" *read* "Gundagai." Line 34, *for* "thin surfaces" *read* "their surfaces." Line 39, *for* "firmness" *read* "fineness." Col. 2 line 31 from top, *for* "wasting" *read* "roasting."

Chemist Wanted; one understanding Preparation of Coal-Tar Products, Aniline, &c., preferred.—Address' stating salary expected and giving references as to experience and character, Box 444, Chemical News Office, Boy Court, Ludgate Hill, London, E.C.

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TO BE SOLD, by TENDER, a Part of the Valuable Machinery and Tar Distilling Plant, Tools, and Effects, at the Naphtha, Creosote, and Patent Coke Works, West Bromwich, comprising—Double-acting Slide-valve STEAM PUMP, 5-inch cylinder, 2½-inch ram; "Reliable" Slide-valve TAR PUMP, with 8-inch steam cylinder, 6-inch ram (Evans, Wolverhampton); Hydraulic Force-Pumps; pair of Contractors' Single-acting Lift-Pumps; 12-inch Single-acting Air Force-Pump, 18-inch stroke; Hydraulic Force-Pumps; three HYDRAULIC PRESSES; three sets of FILTER PRESSES; Hydraulic Pressure-Pumps; Crushing Mill; Vertical Drilling Machine; Foot-Lathe; new Steam Boiler; nine Wrought-iron STORE BOILERS and TANKS; Express "Extincteur" Fire-Engines; Derrick Crane, on carriage; Platform Weighing-machine; Bourdon Pressure-gauge, to indicate 3 tons per inch; Cast-iron Furnace-Boilers; Wheelbarrows; Gas-fitters' Stocks and Dies; Carpenters', Smiths'. and other Tools; Wrought-iron Scrap; Office Furniture; two Iron Safes; and a variety of other effects.

Catalogues and Conditions of Sale may be obtained of the Trustee, HENRY BISHOP, Esq., 41, Coleman Street, London, E.C.; Messrs. JOSEPH COOKSEY and SON, Auctioneers, West Bromwich; or at the Works.

N.B. Tenders of the whole or any part must be delivered to the Trustee on or before Thursday, the 1st of March.

The Vendors do not bind themselves to accept the highest or any offer.

ELECTRIC LIGHT.

AN IMPROVED AUTOMATIC SYSTEM. Any indifferently governed Engine will give quite steady lights. All kinds of Electrical Apparatus.

J. G. STATTER and CO., Limited,
Alliance Engineering Works, West Drayton, near London.

PATENTS, DESIGNS, & TRADE MARKS ACT, 1883.

In the matter of Letters Patent granted to Arthur Favier, of Paris, France, 15, Rue de Richelieu, for "Improvements in the manufacture of explosives and in cartridges containing such improved explosives," dated 16th February, 1885, No. 2139.

NOTICE IS HEREBY GIVEN that the said A. Favier has applied for leave to amend the specification numbered as above.

A copy of the Specification as proposed to be amended can be inspected at the Patent Office, and full particulars of the proposed amendment were set forth in the Official Journal of the Patent Office issued on the 18th of February, 1888.

Any person intending to oppose the said application must leave particulars of his objections thereto (on Form G) at the Patent Office, 25, Southampton Buildings, London, W.C., within one calendar month from the date hereof.

Dated this 18th day of February, 1888.

(Signed) H. READER LACK,
Comptroller-General.

W. P. THOMPSON AND BOULT, Agents,
323, High Holborn, W.C.

THE CHEMICAL NEWS.

VOL. LVII. No. 1475.

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NOTE ON THE DETECTION OF ACETIC ACID IN PRESENCE OF MORPHINE.

By G. STILLINGFLEET JOHNSON, King's College, London.

HAVING frequently been consulted by laboratory students as to the best means of detecting the acetic radicle in morphine acetate, I have reason to believe that the method described below will prove useful to practical chemists. The aqueous solution of morphine acetate is treated with a solution of ferric chloride, both solutions being free from excess of acid. The morphine blue is at once developed, and gives rise to a deep green tint, if the ferric chloride be in large excess.

On warming the colour is changed to blood-red, due to the ferric acetate, which remains stable after the disappearance of the morphine blue.

The following experiment proves that 1 part by weight of morphine acetate dissolved in 870 parts of water gives a very decided reaction.

0·069 grm. of morphine acetate dissolved in 60 c.c. water.

Added 0·0725 grm. of $Fe_2Cl_6.2Aq$ dissolved in 10 c.c. water.

Heat applied with a thermometer in the mixture.

Up to 40° C. the morphine blue became deeper and deeper in tint, but began to fade at 60° C., and had completely disappeared at 80° C., the liquid having now a deep blood-red colour, which remained unchanged after boiling for five minutes. No basic ferric acetate was precipitated.

It is advantageous to be able to detect both base and acid by means of the same reagent.

A slight reddish tint is developed when morphine is dissolved in a neutral solution of ferric chloride and the temperature raised to 100° C., but this reaction is not of a kind to mislead one in the search for acetic acid.

THE DETERMINATION OF VANADIUM IN THE PRESENCE OF CHROMIUM, ALUMINIUM, AND PHOSPHORUS.

AT the meeting of the Newcastle Section of the Society of Chemical Industry, February 8th, 1888, C. W. Ridsdale, F.I.C., F.C.S., read a paper on the above subject. Investigations as to the constitution of basic converter slag* had rendered an enquiry into the value of published methods imperative. The methods examined were—

1. By precipitation as vanadate of ammonia from ammonia extract or other alkaline solution.
2. By precipitation as lead or barium salts, and subsequent decomposition by nitric and sulphuric acids.
3. By colorimetric methods.
4. By titration with permanganate of potash, and analogous methods.
5. By Lindemann's method of titration with ferrous sulphate.

The various difficulties and sources of error were pointed out, and the fifth method shown to be at present the most useful and reliable. An outline for complete analysis of converter slags, &c., in conjunction with the last-named method, was described, and data were furnished as to the effect of vanadium on the precipitation of phosphoric acid, whether as phospho-molybdate of ammonia or ammonio-phosphate of magnesia, and on alumina and chromium sesquioxide.

* *Iron and Steel Inst. Journ.*, vol. i., 1887.

METHODS OF ANALYSES OF DAIRY PRODUCTS.*

BUTTER.

Microscopic Examination.

PLACE a small portion of the fresh sample, taken from the inside of the mass, on a slide; add a drop of pure sweet oil, cover with gentle pressure, and examine with a ½ to ⅛ inch objective for crystals of lard, &c.

Examine same specimen with polarised light and selenite plate.

Pure fresh butter will neither show crystals nor a particoloured field with selenite. Other fats, melted and cooled and mixed with butter, will usually present crystals and variegated colours with the selenite plate.

Specific Gravity.

Take a specific gravity flask, not graduated, the stopper of which carries a delicate thermometer, whose bulb occupies sensibly the centre of the flask. The thermometer should be first compared with a standard instrument.

Clean the picnometer with water, alcohol, and ether; dry, be careful to remove all the ether vapour, and weigh.

Fill with distilled water, insert stopper, and place in vessel containing water which comes nearly to top of picnometer (without stopper); gradually raise the temperature of water in vessel containing flask until it is 40·5° to 41° C.

The moment the thermometer of the picnometer marks 40° remove the flask, dry carefully, cover capillary safety-tube, and set in balance or desiccator to cool. Weigh when temperature falls nearly to that of balance room. Having determined the titre of the flask it is to be carefully dried, filled with the melted and filtered fat at a temperature below 40°, and the weight of the fat determined at 40°, as directed above.

Melting-Point.

Apparatus.—The apparatus, Fig. 1, consists of (1) an accurate thermometer, for reading easily tenths of a degree; (2) a less accurate thermometer, for measuring the temperature of water in the large beaker glass; (3) a tall beaker glass, 35 c.m. high and 10 c.m. in diameter; (4) a test-tube 30 c.m. high and 3·5 c.m. in diameter; (5) a stand for supporting the apparatus; (6) some method of stirring the water in the beaker,—for example, a blowing bulb of rubber and a bent glass tube extending to near the bottom of the beaker; (7) a mixture of alcohol and water of the same specific gravity as the fat to be examined.

Manipulation.—The disks of the fat are prepared as follows:—The melted and filtered fat is allowed to fall from a dropping tube from a height of 15 to 20 c.m. on to a smooth piece of ice floating in water. The disks thus formed are from 1 to 1½ c.m. in diameter, and weigh about 200 m.grms. By pressing the ice under the water the disks are made to float on the surface, whence they are easily removed with a steel spatula.

The mixture of alcohol and water is prepared by boiling distilled water and 95 per cent alcohol for ten minutes, to remove the gases which they may hold in solution. While still hot, the water is poured into the test-tube already described until it is nearly half full. The test-tube is then filled with the hot alcohol. It should be

* Official Methods of Analysis of the Association of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

poured in gently down the side of the inclined tube to avoid too much mixing. If the tube is not filled until the water has cooled, the mixture will contain so many air bubbles as to be unfit for use. These bubbles will gather on the disk of fat as the temperature rises, and finally force it to the top of the mixture.

The test-tube containing the alcohol and water is placed in a vessel containing cold water, and the whole cooled to below 10° C. The disk of fat is dropped into the tube from the spatula, and at once sinks until it reaches a part

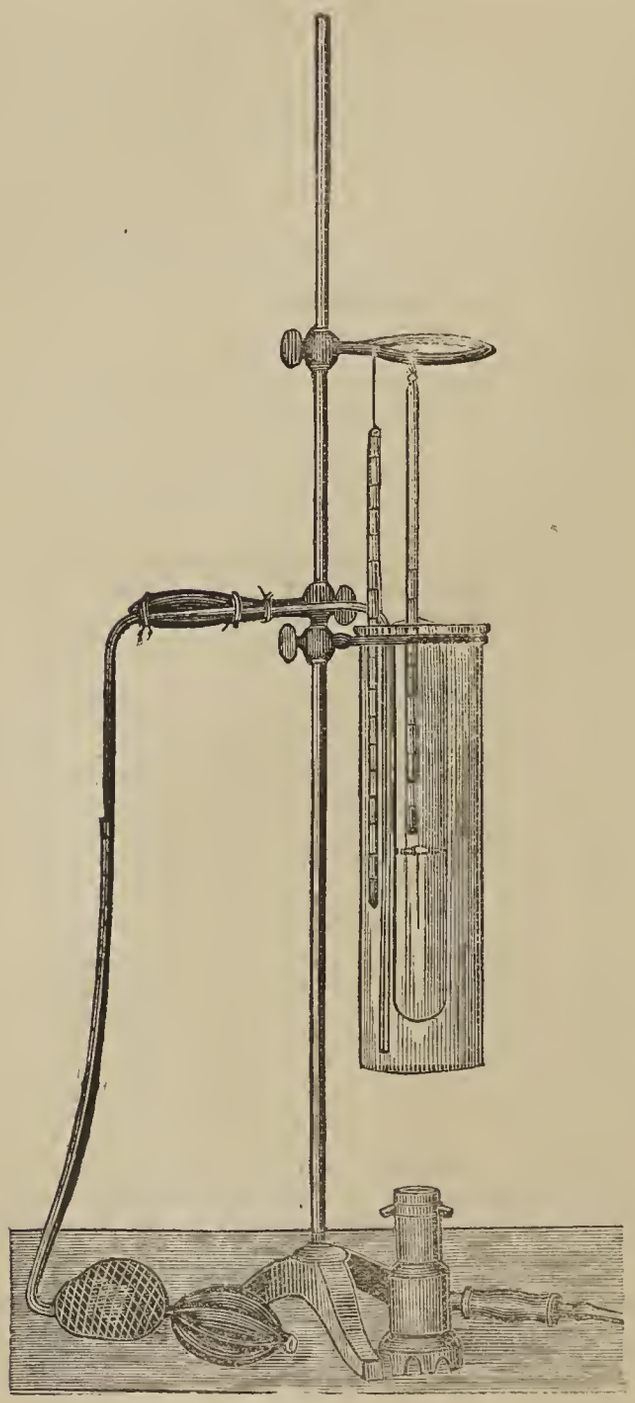

FIG. 1.

of the tube where the density of the alcohol water is exactly equivalent to its own. Here it remains at rest, and free from the action of any force save that inherent in its own molecules.

The delicate thermometer is placed in the test-tube, and lowered until the bulb is just above the disk. In order to secure an even temperature in all parts of the alcohol mixture in the vicinity of the disk, the thermometer is moved from time to time in a circularly pendulous manner. A tube prepared in this way will be suitable for use for several days,—in fact until the air bubbles begin to attach themselves to the disk of fat. In no case did the two liquids become so thoroughly mixed as to lose the property of holding the disk at a fixed point, even when they were kept for several weeks.

In practice, owing to the absorption of air, it has been found necessary to prepare new solutions every third or fourth day.

The disk having been placed in position, the water in the beaker glass is slowly heated, and kept constantly stirred by means of the blowing apparatus already described.

When the temperature of the alcohol water mixture rises to about 6° below the melting-point, the disk of fat begins to shrivel, and gradually rolls up into an irregular mass.

The thermometer is now lowered until the fat particle is even with the centre of the bulb. The bulb of the thermometer should be small, so as to indicate only the temperature of the mixture near the fat. A gentle rotary movement should be given to the thermometer bulb, which might be done with a kind of clockwork. The rise of temperature should be so regulated that the last 2° of increment require about ten minutes. The mass of fat gradually approaches the form of a sphere, and when it is sensibly so the reading of the thermometer is to be made. As soon as the temperature is taken, the test-tube is removed from the bath and placed again in the cooler. A second tube, containing alcohol and water, is at once placed in the bath. It is not necessary to cool the water in the bath. The test-tube (ice water being used as a cooler) is of low enough temperature to cool the bath sufficiently. After the first determination, which should be only a trial, the temperature of the bath should be so regulated as to reach a maximum about 1·5° above the melting-point of the fat under examination.

Working thus with two tubes, about three determinations can be made in an hour.

After the test-tube has been cooled the globule of fat is removed with a small spoon attached to a wire, before another disk of fat is put in.

Volatile Acids.

Take about 2·5 grms. filtered fat in 200 c.c. flask, to be used in subsequent distillation; add 2 c.c. aqueous solution potassium hydrate, containing 0·5 grm. KOH per c.c. Add 2 c.c. 95 per cent alcohol, and heat on water-bath, with occasional agitation. Saponification is complete in a few minutes. Evaporate until alcohol is all driven off, using a current of air to remove alcoholic vapour. The flask is fitted with a delivery tube and condenser, as in Fig. 2. The delivery tube is carried up about 8 inches before it is bent to enter the condenser, and a bulb is blown in it just below the elbow, and this is filled with broken glass or glass-wool.

The fatty acids are then set free with 20 c.c. of a solution of phosphoric acid, made by dissolving 200 grms. glacial phosphoric acid in water and making up to 1 litre. Enough water is added to make the volume of liquid in the flask 70 c.c. Distillation is continued until the distillate measures 50 c.c., which is titrated with—

$$\frac{N}{10}\ NaOH,$$

using phenol-phthalein as indicator.

(Care should be taken to have the potash used free from carbonate. A potash containing carbonate saponifies a a fat with great difficulty, In an instance where the saponification was taking place very slowly, the potash was found to contain 6·80 per eent CO_2, equal to 21·17 per cent K_2CO_3.)

Soluble Acids.

The washings obtained in the process of estimating the insoluble acids, the description of which follows, are made up to 1 litre and an aliquot part taken for titration with one-tenth N alkali, using phenol phthalein as indicator.

Method for the Determination of Soluble and Insoluble Acids.

Reagents.

1. A standard semi-normal hydrochloric acid solution, accurately prepared.

2. A standard decinormal soda solution, accurately prepared; each 1 c.c. contains 0·0040 grm. of NaOH and neutralises 0·0088 grm. of butyric acid, $C_4H_8O_2$.

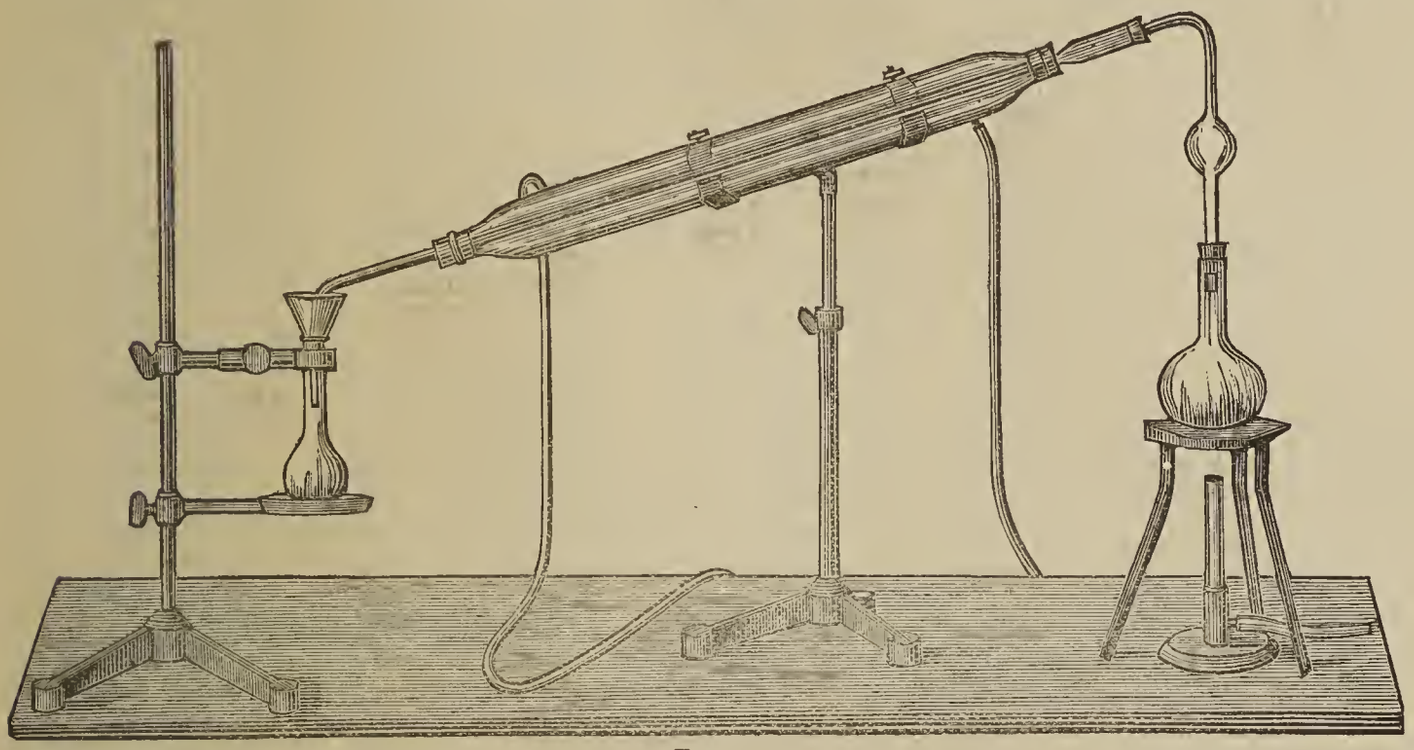

Fig. 2.

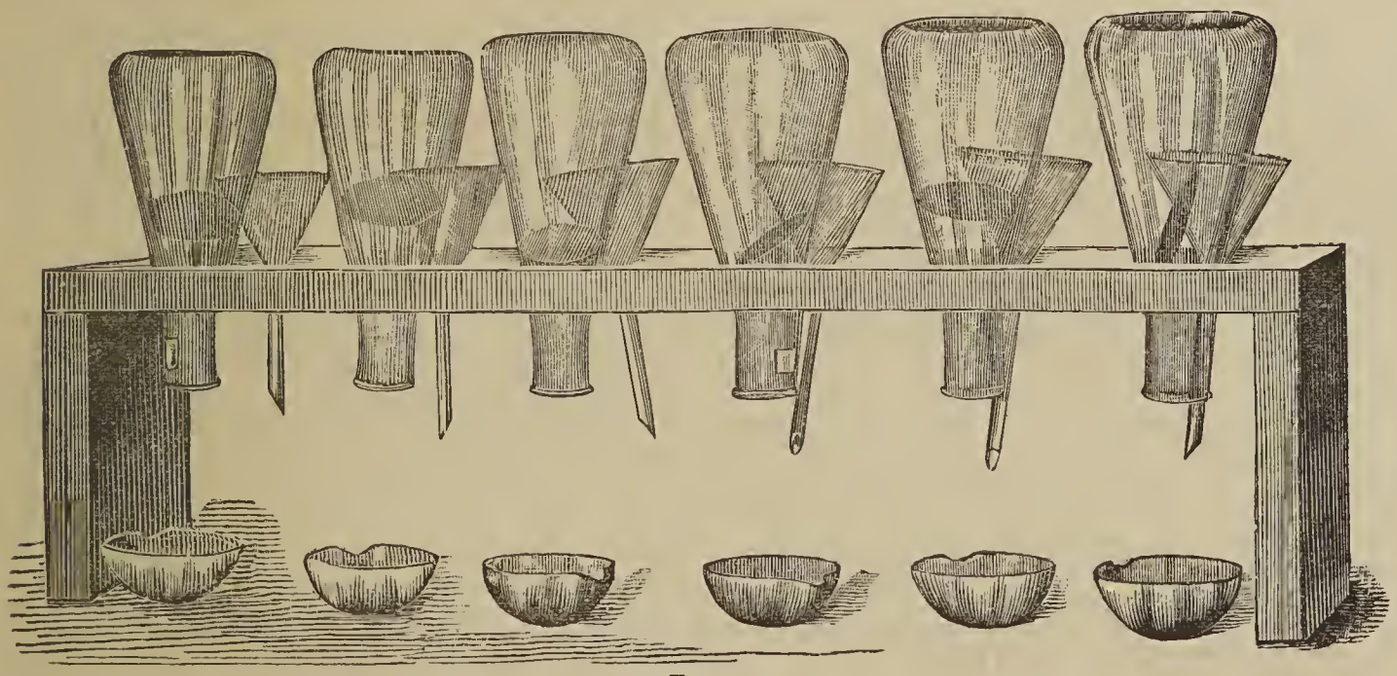

Fig. 3.

3. An approximately semi-normal alcoholic potash. Dissolve 40 grms. of good stick potash in 1 litre of 95 per cent alcohol, re-distilled. The solution must be clear, and the KOH free from carbonates

4. A 1 per cent solution of phenol-phthalein in 95 per cent alcohol.

Saponification is carried out in rubber-stoppered beer-bottles holding about 250 c.c.

About 5 grms. of the melted butter fat, filtered and freed from water and salt, are weighed out by means of a small pipette and beaker, which are re-weighed after the sample has been taken out, and run into a saponification bottle; 50 c.c. of the semi-normal potash are added, the bottle closed, and placed on the steam-bath until the contents are entirely saponified, facilitating the operation by occasional agitation. The alcoholic potash is measured always in the same pipette, and uniformity further insured by always allowing it to drain the same length of time, viz., 30 seconds. Two or three blanks are also measured out at the same time, and treated in the same way.

In from five to thirty minutes, according to the nature of the fat, the liquid will appear perfectly homogeneous, and when this is the case the saponification is complete, and the bottle may be removed and cooled. When sufficiently cool the stopper is removed, and the contents of the flask rinsed with a little 95 per cent alcohol into

Table for the Calculation of Soluble Fatty Acids.

No. c.c. KOH sol.	Equiv. Grms.	N/10 NaOH.	Equiv. Grms.	N/10 NaOH.	Equiv. Grms.	N/10 NaOH.	Equiv. Grms.
10	0·088	+ 0·25	0·0902	+ 0·50	0·0924	+ 0·75	0·0946
11	0·0968	0·25	0·0990	0·50	0·1012	0·75	0·1034
12	0·1056	0·25	0·1078	0·50	0·1100	0·75	0·1122
13	0·1144	0·25	0·1166	0·50	0·1188	0·75	0·1210
14	0·1232	0·25	0·1254	0·50	0·1276	0·75	0·1298
15	0·1320	0·25	0·1342	0·50	0·1364	0·75	0·1386
16	0·1408	0·25	0·1430	0·50	0·1452	0·75	0·1474
17	0·1496	0·25	0·1518	0·50	0·1540	0·75	0·1562
18	0·1584	0·25	0·1606	0·50	0·1628	0·75	0·1650
19	0·1672	0·25	0·1694	0·50	0·1716	0·75	0·1738
20	0·1760	0·25	0·1782	0·50	0·1804	0·75	0·1826
21	0·1848	0·25	0·1870	0·50	0·1892	0·75	0·1914
22	0·1936	0·25	0·1958	0·50	0·1980	0·75	0·2002
23	0·2024	0·25	0·2046	0·50	0·2068	0·75	0·2090
24	0·2112	0·25	0·2134	0·50	0·2156	0·75	0·2178
25	0·2200	0·25	0·2222	0·50	0·2244	0·75	0·2266
26	0·2288	0·25	0·2310	0·50	0·2332	0·75	0·2354
27	0·2376	0·25	0·2398	0·50	0·2420	0·75	0·2442
28	0·2464	0·25	0·2486	0·50	0·2508	0·75	0·2530
29	0·2552	0·25	0·2574	0·50	0·2596	0·75	0·2618
30	0·2640	0·25	0·2662	0·50	0·2684	0·75	0·2706

Erlenmeyer flask of about 250 c.c. capacity, which is placed on the steam-bath, together with the blanks, until the alcohol has evaporated.

Titrate the blanks with semi-normal HCl, using phenolphthalein as an indicator. Then run into each of the flasks containing the fat acids 1 c.c. more semi-normal HCl than is required to neutralise the potash in the blanks. The flask is then connected with a condensing tube 3 feet long, made of small glass tubing, and placed on the steam-bath until the separated fatty acids form a clear stratum on the surface of the liquid. The flask and contents are then allowed to become thoroughly cold, ice water being used for cooling.

The fatty acids having quite solidified, the contents of the flask are filtered through a dry filter-paper into a litre flask, in the manner shown in Fig. 3, care being taken not to break the cake: 200 to 300 c.c. of hot water is next poured on the contents of the flask, the cork with its condenser tube re-inserted, and heated on the steam-bath until the cake of acids is thoroughly melted, the flask being occasionally agitated with a circular motion, so that none of its contents are brought on the cork. When the fatty acids have again separated as an oily layer, the flask and its contents are cooled in ice water, and the liquid filtered through the same filter into the same litre flask. This treatment with hot water, followed by cooling and filtration of the wash water, is repeated three times, the washings being added to the first filtrate. The mixed washings and filtrate are next made up to 1 litre, and 100 c.c., in duplicate, is taken and titrated with decinormal NaOH. The volume required is calculated to the whole liquid. The number so obtained represents the measure of decinormal NaOH neutralised by the soluble fatty acids of the butter fat taken, plus that corresponding to the excess of the standard used, viz., 1 c.c. The amount of soda employed for the neutralisation is to be diminished, for the 1 litre, by 5 c.c., corresponding to the excess of 1 c.c. $\frac{1}{2}$ N acid.

This corrected volume, multiplied by the factor 0·0088, gives the butyric acid in the weight of butter fat employed. (See Table.)

The flask containing the cake of insoluble fat acids is inverted and allowed to drain and dry for twelve hours (Fig. 3), together with the filter-paper through which its soluble fatty acids have been filtered. When dry the cake is broken up and transferred to a weighed glass evaporating dish. Remove from the dried filter-paper as much of the adhering fat acids as possible and add them to the contents of the dish. The funnel, with the filter-paper, is then placed in an Erlenmeyer flask, a hole is made in the bottom of the filter-paper, and it is thoroughly washed with absolute alcohol from a wash-bottle. The flask is rinsed with the washings from the filter-paper and pure alcohol, and these transferred to the evaporating dish. The dish is placed on the steam bath and the alcohol driven off. It is then transferred to the air-bath and dried at 100° C. for two hours, taken out, cooled in a desiccator, and weighed. It is then again placed in the air-bath and dried for another two hours, cooled as before, and weighed. If there is no considerable decrease in weight the first weight will do; otherwise, re-heat two hours and weigh. This gives the weight of insoluble fat acids in the quantity taken, from which the percentage is easily calculated.

The table gives the weight of soluble fatty acids (butyric, &c.) for each quarter of a c.c. of decinormal alkali from 10 to 30.

Example: Weight fat taken (grms.)	4·967
No. c.c. N/10 alkali used	25·50
Less 5 c.c. due to 1 c.c. N/2 acid	20 50
Weight soluble fat acids	0·1804
Per cent soluble fat acids	3·63

Saponification Equivalent.

About 2·5 grms. butter fat (filtered and free from water) are weighed into a patent rubber-stoppered bottle and 25 c.c. approximately semi-normal alcoholic potash added. The exact amount taken is determined by weighing a small pipette with the beaker of fat, running the fat into the bottle from the pipette and weighing beaker and pipette again. The alcoholic potash is measured always in the same pipette, and uniformity further insured by always allowing it to drain the same length of time (thirty seconds). The bottle is then placed in a steam-bath together with a blank containing no fat. After saponification is complete, and the bottles cooled, the contents are titrated with accurately semi-normal hydrochloric acid, using phenol-phthalein as an indicator. The number of c.c. of the acid used for the sample deducted from the number required for the blank gives the number of c.c. which combines with the fat, and the saponification equivalent is calculated by the following formula, in which W equals the weight of fat taken in m.grms. and N the number of c.c. which has combined with the fat.

$$\text{Sap. Equiv.} = \frac{2W}{\quad}.$$

If it is desirable to express the number of m.grms. of potash for each grm. of fat employed it can be done by dividing 5·610 by the saponification equivalent and multiplying the quotient by ten.

Water.

Place about 2 grms. in flat-bottomed platinum dish two-thirds full of clean, dry sand, and heat for two hours in air-bath at 105° C. (For alternate method of estimation of water see article on "Methods of Milk Analysis," to be inserted hereafter).

Estimation of Salt.

Volumetric Method.—The amount of the butter or butter substitute to be taken is 5 to 10 grms.; weigh in a counterpoised beaker-glass. The butter (fresh from the refrigerator) is placed in portions of about 1 grm. at a time in the beaker, these portions being taken from different parts of the sample. By this means a reasonably fair sample of the whole is obtained.

The given quantity having been weighed out, it is removed from the pan.

Hot water is now added (about 20 c.c.) to the beaker containing the butter, and after it has melted the liquid is poured into the bulb of the separating apparatus (Fig. 4).

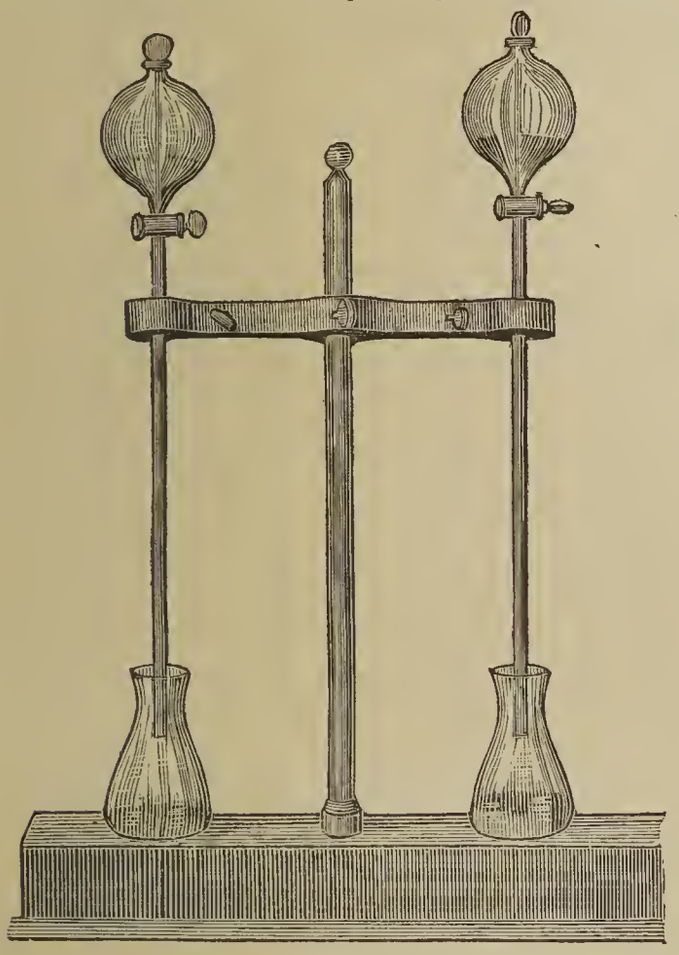

Fig. 4.

The stopper is now inserted and the contents shaken for a few moments.

After standing until the fat has all collected on top of the water, the stopcock is opened and the water, containing most of the salt, is allowed to run into an Erlenmeyer flask, being careful to let none of the fat globules pass.

Hot water is again added to the beaker and thence poured into the separatory apparatus, the bottle well shaken, and the foregoing process is repeated ten to fifteen times, using each time 10 to 20 c.c. water.

The resulting washings contain all but a mere trace of the NaCl, originally present in the butter.

Estimation of NaCl in Filtrate.—The chloride of sodium is now determined in the filtrate by a standard solution of $AgNO_3$, using a few drops of a saturated solution of potassium chromate as indicator.

Total Mineral Matter (Ash) and Curd.

The methods of estimating curd depend on the principle of first drying a weighed portion of the butter, and afterwards extracting the fat with ether or petroleum. The residual mass is then weighed and the curd determined by loss on ignition. This process is carried on as follows:—

Five to ten grms. of butter are dried at 100° C. for a few hours in a porcelain dish. The dried fat, &c., is filtered through a Gooch crucible, the contents of the dish all brought into the crucible and well washed with ether or light petroleum. The filter crucible is dried for two hours in air-bath and weighed. The curd is then determined by loss of weight on ignition.

The total mineral matter is represented by the residue left after ignition.

Curd and insoluble substances may be estimated somewhat more accurately as follows:—

Place the butter (5—10 grms.) in a Gooch crucible; set the crucible on a pad of blotting-paper in an air-bath (100° C.) for an hour, wash two or three times with ether or light petroleum. Dissolve the salt with hot water, dry at 100° C. and weigh. Any insoluble mineral matter and the ash of the curd is weighed with it in this method.

Casein.

Method of Babcock.—Ten grms. of the dried butter are treated with light petroleum until all fat is removed. The residue is then ignited with soda-lime or treated by the Kjeldahl method.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, February 16th, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Messrs. T. A. Lawson and Edward A. Andrews were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Alfred Chiddey, Mount Costigan Smelting Works, Tuena, New South Wales; Harold Nicolai Faber, 56, Dalberg Road, Brixton; James Hart, 131, Embden Street, Manchester; C. Millard King, 63, Frome Park Road, Hornsey, N.; Vivian Byam Lewes, 18, Park Row, Greenwich, S.E.; Frederick Grevile Ruddock, Wilderspool Road, Warrington; H. Belcher Thornton, 11, Esk Terrace, Whitley, Yorkshire; Edward Arthur Wates, 4, Princes Road, Lewisham, S.E.

It was announced that the following changes in the Council List were proposed by the Council:—

As *Vice-Presidents*, Professors Carey Foster and Mallet, *vice* Professors Dewar and Tilden.

As *Members of Council*, Professors Dunstan, Heaton, and Purdie, and Dr. Plimpton, *vice* Messrs. Carteighe, Messel, Newlands, and Stevenson.

Professors Dunstan and Heaton and Dr. Rideal were appointed by the meeting to audit the Treasurer's accounts.

The following were elected Fellows of the Society:—Messrs. Henry Dudley Bevridge, Thomas Fraser Barbour, William H. Barraclough, Alfred Edward Carey, Lewis Smith Cocking, W. Hepworth-Collins, Astley Cooper, John H. J. Dagger, Benjamin H. Gerrans, Christopher James, Charles R. Lafosse, J. Lewkowitsch, Frederick K. S. Lowindes, Thomas Maben, James Mayne, Otto Werbeck, Clifford Richardson, Angus Smith, Sam Smith, Robert Mason Sumner, Arthur J. C. Waterland, John Cuthbert Welch, Emil A. Werner.

The following papers were read:—

11. "*Chemical Investigation of Wackenroder's Solution and Explanation of the Formation of its Constituents.*" By Professor Debus, Ph D., F.R.S.

"Wackenroder's" solution is the solution formed by the action of sulphuretted hydrogen on an aqueous solu-

ion of ulphurous acid till the sulphurous acid is decomposed. The compounds represented by the formulæ $M_2S_3O_6$, $M_2S_4O_6$, $M_2S_5O_6$, and $M_2S_6O_6$, in which M stands for hydrogen or a monovalent metal, are called "Polythionates." The term "acid" is reserved by the author for the so-called anhydrides. The formula SO_2 stands for sulphurous acid, and H_2SO_3 for dihydric sulphite; S_4O_5 for tetrathionic acid, and $H_2S_4O_6$ for hydric or dihydric tetrathionate.

Wackenroder's solution contains, according to our best authors, sulphur in suspension and pentathionic acid in solution. Pure pentathionic acid has never been prepared. The attempts to make salts of the acid also failed. In consequence, Spring a few years ago denied the existence of pentathionic acid, which he declared to be a solution of sulphur in hydric tetrathionate, not in atomic proportions, but of the same description as the solution of sulphur in carbonic sulphide.

To test the correctness of Spring's assertion, the author suggested to Mr. Lewes some experiments with Wackenroder's solution; and Mr. Lewes prepared nearly pure potassic and baric pentathionate. These salts, however, could not be re-crystallised from water, but split up in tetrathionates and sulphur: $K_2S_5O_6 = K_2S_4O_6 + S$. Spring, therefore, would not admit that they were pentathionates, but regards them as mixtures of tetrathionates and sulphur.

In order to remove all doubts about the existence or non-existence of pentathionates, and also to explain some reactions of more than ordinary interest which the author had occasion to observe, whilst Mr. Lewes was carrying out his work, he undertook the experimental investigation described in the paper.

The results briefly stated, are as follows: The filtered Wackenroder solution contains—

(*a.*) Sulphur in suspension in very minute drops.

(*b.*) *A new allotropic modification of sulphur in simple solution, and in the colloidal condition.* This new form of sulphur, Sulphur δ, separates on evaporation of Wackenroder's solution as a yellow, viscous, semi-fluid mass, *partially soluble in much water.* It resembles, in some respects, silica as set free from soluble silicates by strong acids.

(*c.*) Traces of trithionic acid.

(*d.*) Hydric tetrathionate.

(*e.*) Hydric pentathionate.

(*f.*) A polythionate with more sulphur than pentathionates contain, probably hydric hexathionate.

Pure potassic and cupric pentathionates were prepared from Wackenroder's solution, and the reactions of the polythionates carefully investigated. The most interesting of these reactions are *the spontaneous changes of the polythionates in aqueous solutions*; they are indicated by the equations—

(*a.*) $\underset{\text{Pot. pentathionate.}}{K_2S_5O_6} = \underset{\text{Pot. tetrathionate.}}{K_2S_4O_6} + S.$

(*b.*) $\underset{\text{Pot. tetrathionate.}}{2(K_2S_4O_6)} = \underset{\text{Pot. trithionate.}}{K_2S_3O_6} + \underset{\text{Pot. pentathionate.}}{K_2S_5O_6}.$

(*c.*) $\underset{\text{Pot. trithionate.}}{2(K_2S_3O_6)} = \underset{\text{Pot. tetrathionate.}}{K_2S_4O_6} + K_2SO_4 + SO_2.$

(*d.*) $\underset{\text{Pot. trithionate.}}{3(K_2S_3O_6)} = K_2S_5O_6 + 2(K_2SO_4 + SO_2).$

Reactions (*a*) and (*b*) occur reciprocally in either direction with equal facility. From these reactions important conclusions can be drawn with regard to molecular and atomic motion in liquids. The pentathionates resemble persulphide of hydrogen, and are, like ozone and peroxide of hydrogen, endothermic compounds. The similarities which exist, from a chemical point of view, between the polythionates on the one hand and ozone and peroxide of hydrogen on the other, are applied in the paper to explain some of the chief properties of ozone and peroxide of hydrogen.

In the second part of the paper the action of sulphuretted hydrogen and sulphurous acid respectively on the hydrogen salts of the polythionic acids are fully investigated. It is proved that the pentathionic acid of Wackenroder's solution is chiefly derived from the condensation of thiosulphuric acid, thus:—

$$\underset{\text{Thiosulphuric acid.}}{5(S_2O_2)} = \underset{\text{Pentathionic acid.}}{2(S_5O_5)}.$$

$$2(S_5O_5) + 2H_2O = \underset{\text{Hydric pentathionate.}}{2H_2S_5O_6}.$$

The final products of the action of sulphuretted hydrogen on hydric tetra- or hydric penta-thionate are water and sulphur. The statement of the text-books that sulphuretted hydrogen and sulphurous acid produce water and sulphur, is, therefore, correct in so far as the final products are concerned. The polythionates are intermediate products.

Sulphurous acid and potassium thiosulphate or sulphurous acid and the chlorides of sulphur, produce salts of the polythionic acids.

The third part of the paper is devoted to the discussion of the formulæ of the polythionates. It is shown that the following formulæ are the most correct expressions of our experience:—

$K\cdot SO_2\cdot O$	$KS\cdot SO_2\cdot O$
$KO\cdot SO_2\cdot \dot{S}$	$KO\cdot SO_2\cdot \dot{S}$
Pot. trithionate.	Pot. tetrathionate.
$KS_2\cdot SO_2\cdot O$	$KS_3\cdot SO_2\cdot O$
$KO\cdot SO_2\cdot \dot{S}$	$KO\cdot SO_2\cdot \dot{S}$
Pot. pentathionate.	Pot. hexathionate.

12. "*Potilizin's Law of Mutual Displacement of Chlorine and Bromine.*" By T. E. Thorpe, F.R.S., and J. W. Rodger.

On heating bromine with an equivalent quantity of an anhydrous metallic chloride in a sealed glass tube free from air at the temperature of the melting point of zinc, Potilizin found that the amount of chlorine displaced by bromine was greater the higher the atomic weight of the metal in the chloride. Experiments were made with the chlorides of sodium, potassium, silver, calcium, strontium, barium, lead, and mercury. Potilizin further found that if A be the atomic weight of the metal, p the percentage of chlorine displaced from its chloride when treated as above, and E its valency, the formula $\frac{A}{pE^2}$ = a constant, held good in the case of lithium, sodium, potassium, silver, calcium, strontium, barium, lead, mercury, bismuth, tin, and iron. He considered the quantity of chlorine displaced to depend on the atomic weight, valency, and temperature. Arranging the metals in accordance with the periodic law in vertical series, the chlorine displaced was as the atomic weight, $\frac{A}{p}$ being a constant for each series.

Berthelot pointed out that displacement of chlorine by bromine was only possible if the heat of formation of BrCl was greater than the heat absorbed in the direct substitution. Such displacements might, he thought, take place at temperatures at which the chloride was dissociated, so that the bromine would be able to unite with the free metal. He repeated Potilizin's experiments, but found no action up to 400°. Potilizin, in answer to Berthelot, repeated his previous experiments, and further varied the mass of the bromine employed. He used sealed vacuous tubes, heating them at 400—515° or at 300—315°, and found that the chlorine displaced varied with the mass of the bromine, but at a given limit increase in the amount of bromine or of the temperature did not affect the quantity of chlorine displaced. He pointed out that the interaction was not in entire accordance with Berthelot's principle of maximum work, but that it depended partly on this principle and also on the atomic weight, mass, valency, and temperature of the interacting bodies. Berthelot attempted to reconcile Potilizin's statements with his principle by assuming that intermediate compounds—metallic perbromides and chlorobromides together with bromine chloride—were formed and dis-

sociated. In the light of such a supposition he considered the displacement of chlorine by bromine if the latter is present in excess, and the small displacements if the two are in equivalent proportions, to be in accordance with the provisions of thermal chemistry.

In answer, Potilizin stated that he verified the formula $\frac{A}{pE^2}$ = a constant, in the case of 14 chlorides, also in the case of nickel and cobalt. He denied that intermediate compounds could exist at the temperature of the interaction, and thought the cause of the interaction must be sought for "in the intramolecular conditions of the bodies; being probably dependent on the varying rates of the molecules."

No further work appears to have been done on the subject, and in order to test the validity of the law stated by Potilizin the following experiments were instituted:—

An amount of bromine equivalent to about 1 grm. of anhydrous chloride was sealed off in a small glass bulb, and a quantity of the salt, exactly equivalent to the quantity of bromine taken, was weighed out into another bulb, and the two were placed in a piece of glass tubing closed at one end. At about 6 inches from the closed end the tube was thickened in the flame and drawn out into a thick capillary. Beyond this point it was drawn out and bent so as to be evacuated by the Sprengel pump. When the exhaustion was complete the tube was sealed up by directing a blowpipe flame on to its capillary portion; the point was then annealed and the tube allowed to cool. The bromine bulb was next broken and the chloride distributed as uniformly as possible over the inside of the tube, in order to expose it most advantageously to the action of the bromine. By means of an air-bath the tubes were heated to about the boiling point of mercury in some cases and to about 450° in others.

After heating, the tubes were freed from any adherent oxide of iron due to contact with the iron tubes of the bath, by immersion in warm chlorhydric acid, washed, dried, opened by means of a hot wire on a piece of glazed paper, and heated at 120° till the free bromine was expelled and the weight constant. Lastly, the contents of the tubes were washed out and the empty tubes weighed. From the increase in weight of the chloride taken the amount of bromine substituted and hence the chlorine displaced could be calculated. The results of the experiments carried out in this way are given in the subjoined table. Chlorides marked with the same letter were heated simultaneously:—

It will be seen that only on one occasion—in the case of silver chloride—was a number got in anything like agreement with the figures demanded by Potilizin's law. In all other cases the amount of chlorine displaced was considerably less than that required by the law. The table, however, shows, that although the amount of chlorine displaced stands in no definite relation to the atomic weight of the metal in the chloride used, yet in all cases most chlorine is displaced from the chloride of highest molecular weight when several are heated simultaneously. Further, in all cases with the exception of silver chloride, the longer the time of heating the more chlorine was substituted, and hence it might be thought that if the time of heating were sufficiently prolonged a limit would be reached. On the other hand, in no instance was the amount of chlorine displaced in any one chloride proportional to the time of heating; even after heating sodium chloride for 120 hours scarcely half the quantity demanded by Potilizin's law was substituted. In the only case in which Potilizin gives definite data, viz., in the case of barium chloride, the percentage of chlorine displaced was 7·78 on heating from two to six hours at 400°, whereas we obtained only 4·8 on heating for seventeen hours at about 450°.

Chloride used.	Temperature of bath.	Time of heating.	Percentage of chlorine replaced.	Percentage given by the law.
(*a*) NaCl ..	about 350°	8 hours	0·5	5·5
(*b*) NaCl ..	„ 450	14 „	1·84	5·5
NaCl ..	„ 450	120 „	2·6	5·5
(*a*) KCl ..	about 350°	8 hours	2·7	9·78
(*b*) KCl ..	„ 450	14 „	3·4	9·78
(*a*) AgCl ..	about 350°	8 hours	23·3	27·28
(*b*) AgCl ..	„ 450	14 „	24·7	27·28
AgCl ..	„ 350	8 „	27·42	27·28
(*c*) $SrCl_2$ ..	about 450°	17 hours	1·3	5·2
(*c*) $BaCl_2$..	about 450°	17 hours	4·5	7·78
(*c*) $PbCl_2$..	about 450°	17 hours	5·0	12·4

The authors consider that these observations altogether disprove the validity of Potilizin's law of displacement.

13. "*A Gasometric Method of Determining Nitrous Acid.*" By Percy F. Frankland, Ph.D., B.Sc., F.I.C.

The method is based on the well-known interaction of urea and nitrous acid. The author evaporates a definite volume of the solution containing the nitrite to dryness in a small beaker on the water bath, the residue is then dissolved in a few c.c. of hot distilled water, and transferred along with an excess of urea to a tube standing over mercury. Dilute sulphuric acid is then admitted, whereupon an evolution of nitrogen and carbonic anhydride takes place. The reaction is found to be complete in fifteen minutes. An excess of a strong solution of pure caustic soda having been admitted into the tube to absorb the carbonic anhydride, the residual nitrogen is transferred to a gas-apparatus and measured.

The method was found to yield very satisfactory results.

The method was also employed for determining nitrites in the presence of nitrates and ammonia: the nitrate was destroyed by evaporating one portion of such a mixture with excess of ammonium chloride, and the nitric acid in the residue was then determined by the mercury method; whilst another portion was evaporated with an excess of pure caustic soda—to prevent the destruction of the nitrite by the ammonia present—and in the residue the nitrous acid was determined by the urea method.

14. "*The Action of Some Specific Micro-organisms on Nitric Acid.*" By Percy F. Frankland, Ph.D., B.Sc., F.I.C.

The author has investigated the behaviour, when grown in nutritive solutions containing nitrates, of a number of micro-organisms obtained from air and water, and cultivated in a state of purity. Of 32 different forms so examined, 16 or 17 were found to reduce the nitrate to nitrite more or less completely, whilst the remainder were quite destitute of this power. The behaviour of the various organisms was not altered in this respect by excluding air from the solutions in which they were cultivated. In a number of cases the changes taking place in the condition of the nitrogen were followed quantitatively. In some cases ammonia made its appearance in the solutions, but by quantitative experiments it was found that this ammonia was due to the decomposition of peptone, which was the only other nitrogenous ingredient besides the nitrate in the cultivating medium employed. A number of special experiments were made with two micro-organisms, *Bacillus ramosus* and *B. pestifer*, which powerfully reduce nitrates to nitrites, and which also give rise to the appearance of ammonia in the peptone-culture-fluid. In these experiments it was found that the nitrite produced in a given time was augmented by increasing the organic matter, peptone, and sugar present in the solution, and that the peptone was much more potent in effecting this increase than the sugar. It was further found that the ammonia generated in these experiments was increased by raising the proportion of peptone to sugar, and diminished by increasing the proportion of sugar to peptone.

In nearly all cases in which partial or total reduction of

nitrate to nitrite had taken place, the sum of the nitrogen as nitrate and nitrite in the fermented solution was practically identical with the nitrate in the original unfermented solution; whilst in those cases in which no reduction to nitrite took place, the nitrate in the solution remained practically unaffected by the growth of the micro-organisms. In one case, however, it was found that an organism, *B. aquatilis*, which does not reduce nitrates to nitrites, caused by its growth, the disappearance of a considerable proportion of nitric nitrogen, the deficiency not being accounted for by the small proportion of ammonia which was generated in the solution. It is pointed out how this difference in reducing power may in certain cases be of great value in distinguishing between micro-organisms morphologically very similar.

15. "*The Action of Phosphorus Pentachloride on Salicylaldehyd.*" By CHARLES M. STUART, M.A.

The author finds that phosphorus pentachloride converts salicylaldehyd into the phosphate of dichlororthocresol, $PO(O\cdot C_6H_4.CHCl_2)_3$, and not into dichlorothocresol, as stated by Henry (*Ber.*, 1869, 135).

Dichlororthocresylic phosphate is not altered by boiling with potassium hydroxide solution. By the action of phosphorus pentachloride on orthomethoxybenzaldehyd, orthomethoxybenzal chloride, $C_6H_4(OCH_3)\cdot CH_2Cl_2$, is obtained; this is readily re-converted by the action of warm water into the aldehyd from which it was formed.

16. "*Some Interactions of Nitrogen Chlorophosphuret.*" By WARD COULDRIDGE, B.A.

The paper is chiefly devoted to the description of experiments on the action of amines on nitrogen chlorophosphuret, $P_3N_3Cl_6$, the compound which results on heating together phosphorus pentachloride and ammonium chloride; the small yield obtained by this process is attributed by the author to the formation of phospham, $P_3N_3(NH)_3$, by the action of ammonia on the chlorophosphuret. He finds that the compound $P_3N_3(NH\cdot C_6H_5)_3$, which Hofmann prepared by treating the chlorophosphuret with aniline, is not altered by heating with muriatic acid at 150°, but that at 250° it is resolved into phosphoric acid, ammonium chloride and aniline chlorhydride. By the action of ortho-toluidine, a compound of the formula—

$$P_3N_3(NH\cdot C_6H_4\cdot CH_3)_6$$

was obtained, and similar compounds were prepared from phenylhydrazine and piperidine. Attempts to displace the chlorine by cyanogen were unsuccessful, and experiments with sodium and with zinc ethide also gave negative results.

17. "*Action of Alcohols on Ethereal Salts in Presence of Small Quantities of Sodic Alkylate.*" By T. PURDIE, Ph.D., B.Sc., Professor of Chemistry in the University of St. Andrews, and W. MARSHALL, B.Sc.

The addition of a minute quantity of sodic alkylate to a mixture of an alcohol and an ethereal salt induces an extensive interchange of alkyl radicle between the two substances. The authors having examined the interaction in the case of a number of ethereal acetates and alcohols of the $C_nH_{2n+1}OH$ series, find that a much greater interchange occurs when the alcohol of complex radicle acts on the ethereal salt of simple radicle than in the converse interaction. The numerical results obtained indicate that, excluding the methyl radicle, the affinity of the alkyl radicles for the hydroxyl oxygen of the acid, as measured by the interaction under consideration, increases with increasing complexity of the alkyl radicle; but that with regard to the methyl-radicle its affinity is greater than that of the ethyl and less than that of the amyl radicle.

18. "*Note on the Densities of Cerium Sulphate Solutions.*" By B. BRAUNER, Ph.D.

The author has determined the densities of solutions of the anhydrous and of the hydrated salt, and finds that the values are identical for solutions of equal concentration.

PHYSICAL SOCIETY.

February 25th, 1888.

Professor REINOLD, F.R.S., President, in the Chair.

MR. HUGH FRANK NEWALL was elected a Member of the Society.

The PRESIDENT read a letter received from the Council of the Royal Meteorological Society, referring to the forthcoming Exhibition of Apparatus used in Observations of Atmospheric Electricity, and requesting the loan of such apparatus belonging to Members of the Society.

The following papers were read:—

"*Note on the Efficiency of Incandescent Lamps with Direct and Alternating Currents.*" By Prof. W. E. AYRTON, F.R.S., and Prof. J. PERRY, F.R.S.

This relates to the question whether the "efficiency" (candles per Watt) is greater or less for alternating than for direct currents. Experiments made by Messrs. Shepherd and Wheatley, two of the students at the Central Institution (to whom the authors express their thanks for the valuable assistance rendered), show that no appreciable difference can be detected when the lamp is at the same candle-power.

In performing the experiments three way switches, in connection with Gramme and Ferranti machines, were arranged so that the current through the lamp could be quickly changed from direct to alternating, or *vice versâ*, adjustable resistances having been previously placed in the two circuits to give equal readings on a Cardew voltmeter placed as a shunt to the lamp. The currents were measured by a reflecting dynamometer, wound with fine wire, in order to make the error due to unequal current density over the section, negligible. The problem has also been investigated from theoretical considerations, but the results, as yet deduced, would not lead the authors to anticipate the equal efficiency found experimentally.

An interesting discussion followed, in which Mr. SWINBURNE, Prof. S. P. THOMPSON, Mr. BOYS, and the Authors took part.

"*Observations of the Height, Length, and Velocity of Ocean Waves.*" By the Hon. RALPH ABERCROMBY, F.R. Met. Soc.

Several sets of observations were made by the author in the South Pacific in 1885. The heights were measured by a sensitive aneroid, and the length and velocity by a chronograph assuming the length and speed of the vessel to be known. The largest waves observed in a heavy sea gave a height of 46 feet, length 765 feet, velocity 47 miles per hour, and time-period of 16·5 sec. Great discrepancies exist between the results of different observers, which the author believes to be chiefly due to the comparative rarity of well-defined simple waves.

Replying to a question from Mr. BAILY, the Author said the effect on the barometer, of the difference of wind pressure on the two sides of a wave, was negligible.

"*On the Temperature at which Nickel begins suddenly to lose its Magnetic Properties.*" By Mr. HERBERT TOMLINSON, B.A.

Different authorities give different values ranging from about 300° to 400° C. In investigating the subject the author found that the said temperature depends on the magnetising force used; *e.g.*, with magnetising forces of 5, 99, and 182 units, the temperatures at which the permeability attained its maxima were 287° C., 248° C., and 242° C; and those corresponding to permeability o were 333°, 392°, and 412° respectively.

From these above results it will be seen that for small magnetising forces the change of permeability from maximum to o is much more sudden than for the greater forces. As in iron, the permeability decreases as the magnetising force increases. An experiment was shown in which a nickel-plated brass wire was heated to dull redness whilst suspended between the poles of an electro-

magnet, and allowed to cool. When the critical temperature was attained the wire was suddenly attracted to one or other of the poles.

In reply to Mr. SHELFORD BIDWELL the Author stated that the changes in permeability due to ordinary atmospheric changes of temperature were considerable, when small magnetising forces were used.

"*Experiments on Electrolysis.*" By Mr. W. W. HALDANE GEE, B.Sc., Mr. H. HOLDEN, B.Sc., and Mr. C. H. LEES, B.Sc.

Whilst studying some electrolytic polarisation phenomena with palladium electrodes in dilute sulphuric acid (pure), a dense liquid was seen, *after reversing the current*, to flow downwards in streaks from the anode.

The paper is devoted to the investigation of the character of the liquid streaks, and the authors conclude that the streaks are of concentrated sulphuric acid formed by the union of the hydrogen (occluded by the electrode whilst serving as cathode) with the SO_4 liberated at the same electrode when the current is reversed.

Similar streaks were found with phosphoric acid, &c.

In their next paper the authors hope to describe some experiments in which these and similar effects become of great importance in changing the resistances of electrolytes.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

SIR,—Mr. R. J. Friswell, in his letter of February 18th (CHEMICAL NEWS, vol. lvii., p. 79), says he was one of the original Council and had some share in the movement which brought about the foundation of the Institute, and I therefore should like to ask him :—

What actual substantial benefits the Institute was intended to confer upon its Fellows over and above those enjoyed by non-Fellows ?

What benefits—substantial, not sentimental—has the Institute conferred upon its provincial Fellows in return for their support ?

What substantial benefits have provincial Fellows a right to expect from the Institute ?

A satisfactory answer to these questions will do much to remove the existing discontent. Of course this cannot appear before the new Council is elected, but a few straws of this kind may show which way the wind blows, and guide their future course.—I am, &c.,

W. JESSE LOVETT.

MODIFICATION OF SOXHLET'S APPARATUS.

To the Editor of the Chemical News.

SIR,—I have read with interest Mr. J. J. Barlow's article (CHEMICAL NEWS, vol. lvii., p. 56) on "An Improved Modification of Soxhlet's Apparatus for the Extraction of Oil and Fat in Plants, Foods, &c." ; but although Mr. Barlow's device may be an improvement as far as economy goes, I venture to assert that it can scarcely be looked upon as an improvement in point of efficacy. On the other hand, it must, in my opinion, be looked upon rather as an improvement in the wrong direction, since it lacks the most important function of Soxhlet's cleverly constructed arrangement, of bringing the substance to be extracted into contact with the *freshly distilled* solvent until the latter syphons itself off. This contact lasts the whole time during which the extraction is going on, whereas in Mr. Barlow's arrangement the freshly distilled liquid only comes into contact with this substance periodically for a few seconds, viz., while the liquid which has collected in T is being syphoned off, and then the greater part will trickle down the side of the bag and have little or no effect.

Another objection to Mr. Barlow's "Improved Modification" lies in the fact that the cotton bag (which, by the way, would certainly not be fine enough for some substances) lies soaking in the concentrated extract contained in the flask. When taken out it must necessarily retain by capillary attraction a very considerable proportion of the latter, which if not taken into consideration would lead to serious errors.

Upon the whole, I fail to see any improvement in Mr. Barlow's arrangement on the rough and ready method of boiling the substance with the solvent in a flask, and then filtering.—I am, &c.,

EDMUND KNECHT, Ph.D.

Chemistry and Drying Department,
Bradford Technical College, Feb. 20, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 6, February 6, 1888.

One of the Bases Extracted by M. Morin from Liquids which have undergone the Alcoholic Fermentation.—M. Tanret.—One of these bases has received the formula $C_7H_{10}N_2$. The author, in June, 1885, made it known that by the action of free ammonia or of the ammoniacal salts of organic acids upon glucose there are formed volatile bases which he named glucosines. M. Morin's base corresponds in its formula and properties to glucosine β.

Zeitschrift fur Analytische Chemie. Vol. xxvi., Part 3.

Determination of Sulphur and the Halogens in Organic Substances.—P. Claesson.—This paper requires the accompanying illustration.

Determination of Crystalline Water in Organic Matter Containing Iodine.—E. Ostermayer.—An ordinary combustion-tube 30 c.m. in length is connected on the one end with an aspirator and an intermediate calcium chloride tube, and at the other end with an upright tube containing the substance under examination, which is again connected with a "desiccation system." The combustion tube is charged with two spirals of copper, or preferably of silver, which can be heated by means of two Bunsen burners. The tube containing the substance is immersed for two-thirds of its depth in an oil-bath which is heated to the temperature necessary for the determination. The spirals are slightly heated, and a current of dry air is aspirated through the tube. Any iodine which is carried along by the air is retained by the spirals, whilst the watery vapour alone arrives in the calcium chloride tube.

Determination of Fusel Oil.—H. Rose compares the increase of volume observed in known quantities of chloroform shaken up respectively with a fuseliferous spirit and with a pure spirit of the same strength, and calculates the difference as fusel. J. Traube determines the heights to which pure and fuseliferous spirits ascend respectively in capillary tubes under identical conditions.

Examination of Mealy Substances for Binitrocresol and Picric Acid.—Fleck.—Both these colouring-matters may be extracted with alcohol. The solution is evaporated down in a small porcelain capsule ; upon the residue is poured a little dilute hydrochloric acid (10 per cent). Picric acid is at once decolourised ; bininitrocresol not until a few minutes have elapsed. If a piece

of pure zinc is then laid in the liquid and let stand without heating a fine blue colour appears in one to two hours in case of picric acid, and a light blood-red in case of binitro-cresol.

Examination of Butter.—Notices of a number of papers on this subject by E. Sell, A. Mayer, A. Müller, J. Skalweit, Wolckenhaar, E. König, C. Virchow, E. Duclaux, A. Upmeyer, Scheffer, W. Fox, and J. A. Wanklyn.

The Flashing-point of Crude Petroleum.—Th. Rosenbladt (*Chemiker Zeitung*).—The process in question is not given.

Proportion of Phenol in Crude Carbolic Acid.—H. Beckurts.—The author mixes a given volume of the sample with an equal volume of petroleum-ether and shakes up the whole in a graduated jar with a 10 per cent soda-lye. A complete separation of the alkaline liquid from the hydrocarbons ensues with ten minutes. The volume of the matter insoluble in soda, less the volume of the petroleum-ether added, shows the volume of the neutral oils present.

Examination of Paper.—C. Wurster.—The author accounts for the yellowing of paper on exposure to light by the formation of a colouring-matter connected with an "activation" of oxygen. This process he refers to the presence in the paper of the resin used in sizing, which, in a state of fine division, seems to act like oil of turpentine. He shows the presence of activated oxygen by means of tetra-methyl-para-phenylen-diamine paper (Schuchardt, of Goerlitz). If such paper is moistened with water and pressed between paper sized with resin it turns in a few minutes to a blue-violet, whilst paper free from resin is scarcely coloured. To detect mechanical wood-stuff in paper Wurster presses slightly a test-paper saturated with dimethyl-para-phenylen-diamine and folded twice or four times between sheets of the sample. If mechanical wood-stuff is present the paper turns red. Chemical wood-stuff shows this reaction very slightly or not at all. Many papers turn metal foil, especially silver, brownish or yellowish, and have an unpleasant action upon metal objects with which they come in contact. This depends on the presence of sulphur or chlorine. According to R. Kayser these impurities may be detected by placing a piece of silver-leaf between sheets of the paper and exposing it to a jet of steam for half-an-hour.

MEETINGS FOR THE WEEK.

MONDAY, 5th.—Medical, 8.30.
— Society of Chemical Industry, 8. "The Recovery of Sulphur from Alkali Waste by Means of Lime Kiln Gases," by Alexander M. Chance.
— Royal Institution, 5. General Monthly Meeting.
— Society of Arts, 8. "The Modern Microscope," by John Mayall, Jun.

TUESDAY, 6th.—Institution of Civil Engineers, 8.
— Pathological, 8.30.
— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
— Society of Arts, 8.. "South African Goldfields," by W. H Penning, F.G.S.

WEDNESDAY, 7th.—Society of Arts, 8. "Framework Knitting," by W. T. Rowlett.

HURSDAY, 8th.—Royal, 4.30.
— Royal Society Club, 6.30.
— Telegraphic Engineers, 8.
— Medical, 8.30. (Anniversary).
— Mathematical, 8.
— Royal Institution 3. "Microscopical Work with Recent Lenses on the Least and Simplest Forms of Life," by The Rev. W. H. Dallinger, LL.D., F.R.S.

FRIDAY, 9th.—Astronomical, 8.
— Quekett Club, 8.
— Royal Institution 9. "S. T. Coleridge," by Leslie Stephen, M.A.

SATURDAY, 10th.—Royal Institution, 3. "The Modern Drama: French," William Archer.
— Physical Society, 3. "On a Reflecting Galvanometer," by G. L. Addenbroke. "On a Theory concerning the Sudden Loss of Magnetic Properties of Iron and Nickel at a High Temperature," by Mr. Herbert Tomlinson.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1476.

10 MAR 88

ON THE

DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

The above was the title of a Memoir published by the late E. F. Teschemacher, jun., in the Chemical News of February 2nd, 1877, re-printed and distributed by him amongst analysts and others known to be interested in the subject. This title we also adopt as best describing the results of the last ten years' work on numerous samples of opium we have examined during this time, our amendments in the process of 1877, and our careful investigation of some of the best, most prominent, and authoritative processes published by others during, or somewhat before, this period.

In 1882 Mr. Allen, of Sheffield, was good enough to send us an excerpt of some 150 pages from his important work, "Commercial Organic Analysis," containing many useful details and remarks on the determination of morphia in opium. He begins by saying—"The accurate estimation of morphia in opium is attended with peculiar difficulties, and hence few of the numerous published processes for the assay of opium are really trustworthy." Permit us to substitute "none" for "few," and, qualifying this by "within our knowledge," we most heartily agree with Mr. Allen; but must be allowed to totally differ from him when he adds—"In addition to the method of assay prescribed in the *British Pharmacopœia*, the following are very satisfactory processes."

To this process of the *British Pharmacopœia* (1867) we shall presently return, whilst as to that due to Prollius, and its modification by Petit, cited by Mr. Allen, they cannot possibly yield results in the least degree trustworthy, owing to the large quantities of alcohol employed in both processes.

We now come to the method of Flückiger, extracted from the *German Pharmacopœia Report*, by which, after the treatment of the dried opium by ether, to remove wax, narcotin, and colouring-matter, the residual opium is exhausted by water, and a known portion of this solution by a mixture of ether and alcohol of 0·815 sp. gr.; afterwards by solution of ammonia, and collecting the morphia after the expiration of twenty-four hours. Here, again, the quantity of alcohol must interfere with the correctness of the results, and this conclusion appears to have been experimentally arrived at by Mylius, who found the determination of morphia by this process to be below the truth. Mylius, however, is guilty of proposing to add a given weight to that of the morphia obtained, to ensure, in his opinion, a correct result,—to our eyes an unpardonable sin in an analyst, as tampering with the actual results, and thus leading directly to untrue and fallacious returns.

This process of Flückiger seems to attract analysts, for we find in page 724 *et seq.* of the *Pharm. Journ.* (vol. xii.) full details of a method devised by Dr. E. R. Squibb, of the U.S.A., and based on Flückiger's method; but alas! the new method is so overlaid with detail that we fear the tyro in analysis—for whose use these instructions must have been intended—would be crippled by their minuteness and multiplicity, so that his best efforts would most likely be attended by disappointment and failure. Even the editor of the *Pharm. Journ.*, who has reprinted Dr. Squibb's emendation of Flückiger, thinks it requisite to warn his readers who may adopt this method that they must "not be discouraged if very many trials be needed to render them expert enough to obtain tolerably accurate and uniform results,"—an opinion so discouraging that we fear few would venture on mastering this process, especially as the author of it appears to have concluded his remarks with, to our minds, this fatal one,—"but there will always be some loss."

By the courtesy of Mr. C. M. Stillwell, M.A., of New York, we have received a memoir entitled "On the Analysis of Opium," which proves to be not a method for the analysis of opium, but a still further modification of the Flückiger-Squibb process for the determination of morphia present in opium.

A reprint of Mr. Stillwell's paper occurs in the Chemical News (vol. lv., pp. 41 and 54) As Mr. Stillwell sets a very high value on his process, it is but right that we should let him speak for himself when introducing it. He says:—"In presenting a method for the analysis of opium, as an addition to the many processes published from time to time, I feel justified on account of the importance which a correct analysis of this costly substance demands. The use of the two washing solutions, to be described hereafter, is an important step towards obtaining a pure precipitate of morphia; and the final purification of the crystalline precipitate, proposed by myself, I find to be absolutely necessary for the correctness of the analysis. To this latter point I call special attention. The process of Dr. Squibb, used as he directs, *will give results which are almost exactly comparable amongst themselves.*" This *dictum* of Dr. Squibb we have ventured to italicise, which we have found to be so constant and true that for convenience sake we have dubbed it "Squibb's Law." "It can be used, therefore, as a control; but to obtain analytical results such as are needed for buying and selling, a still greater degree of accuracy is required. For this purpose I believe the method now to be described to be of great value."

Instead of so doing Mr. Stillwell delays the fulfilment of this promise for a space of upwards of three pages of his pamphlet, when he renews his promise, and, we are glad to say, keeps it:—

"As regards the accuracy of the process, about to be described, the following results may be of interest:—An opium, very uneven in quality, was sampled by one of our men, and I made the analysis, obtaining water 24·30, morphia 11·75 per cent. Three months afterwards the same lot was re-sampled, and analysed by me in duplicate: the results were—Water 24·70, morphia 11·70 and 11·82; average 11·76 per cent."

This test scores for the storage and sampling, but as for its testimony to the accuracy of the process we fail to discern it, whilst we find a confirmation of Squibb's Law, which we find to be very constant with opium processes carried out in precisely similar methods, and yielding similar, it is true, but far distant from accurate, results.

To quote Mr. Stillwell *in extenso* would but needlessly weary both our readers and ourselves, so that we shall confine our description to a summary of his process, in the which we are the more encouraged by his own example of summarising his method at the conclusion of his memoir. After directions for the sampling of and the preparation of the sample, the process begins by exhausting about 10 grms. by water; then concentrating this aqueous solution in a water-bath to 25 c.c., to which 5 c.c. of alcohol, of 0·820 sp. gr., are to be added and stirred to ensure mixture. This solution is now to be transferred to an Erlenmeyer flask, and 5 c.c. more of alcohol are to be added, and the liquids mixed by a rotary motion. Now add 30 c.c. of ether, of 0·728 sp. gr., and mix again by rotation; to this further add 4 c.c. of solution of ammonia, sp. gr. 0·960, and shake the flask vigorously until an arenaceous precipitate falls. Set the flask aside for twelve hours. Then filter the ethereal portion from the flask as closely as possible, having previously well wetted the filter with ether; add 20 c.c. of ether to the solution in the flask, and rotate; again pour the ethereal solution on to the covered filter, and finally wash the filter with 5 c.c. of

ether, and allow it to drain and dry. Then collect on the filter the crystalline contents of the flask; rinse this twice, with 5 c.c. of water each time. Wash the filter and crystals carefully with 10 c.c. of water; drain and dry this first on bibulous paper, and then at 212° F. This, with any crystals adherent to flask, will give the total yield of morphia in clean, distinct, small light brown crystals. This is apparently the conclusion of Mr. Stillwell's process, described in seven pages of letterpress.

"This process, according to the skill and care bestowed, will give uniform results within two- or three-tenths of a per cent." We are now told that with adulterated opiums "the results are almost always too high," whilst with poor opiums these "are liable to be too low," involving a serious modification of the process. These conditions we must submit are almost, if not wholly, condemnatory of the process; whilst now we quickly light on the statement that, "in following out the above plan of Dr. Squibb, several difficulties are met with."

The above plan of Dr. Squibb. What does this mean? We hark back until we find the name of Dr. Squibb, when it is quoted in connexion with and in condemnation of "processes which depend on the use of lime, and of an aliquot portion of the filtrate"; and this is considered and concluded in p. 4 of the pamphlet. Mr. Stillwell afterwards continues the description of his own process, sometimes with, but more often without, quotation-marks, and sometimes commencing a sentence with quotation-marks which are omitted when the paragraph is concluded, to the utter bewilderment of his readers. At last we are driven to the belief that when inverted commas are used, or partially used, they signify Flückiger's process amended by Dr. Squibb; when they are not used, Dr. Squibb's process amended by Mr. Stillwell. It is, however, most difficult to decide whether it is Dr. Squibb speaking or Mr. Stillwell. It is Mr. Stillwell, most certainly, who says in p. 10 "In following out the above plan of Dr. Squibb several difficulties are met with." These difficulties appear to be a deficiency of ether, and also of water used for washing the precipitate of morphia, &c., obtained in Dr. Squibb's process, which contains "insoluble matter, resinous and other organic matters, and meconate of lime, the latter constituting about 25 per cent of the impurities present. The average amount of the impurities present in the crystals obtained by his process is 8 per cent of the weight of the crystals. The meconate of lime extracted by the acid solution of the opium is retained in solution until the addition of ammonia, when it is precipitated with the crystals of morphia, and remains with them until the final weighing. The resinous and other organic matters soluble in alcohol, but insoluble in water, are not thoroughly removed by the limited washing given in his process, and no provision is made for their subsequent removal."

Alas for Dr. Squibb and his amended Flückiger process! Will our readers please to remember that it is Mr. Stillwell speaking, not Teschemacher and Smith?

These considerations, which generally we must endorse, have compelled Mr. Stillwell to a fresh start by adopting the *morphiated spirit* and *morphiated water* described by our late Mr. Teschemacher, jun., and long employed by us. Of these reagents Mr. Stillwell observes:—"By washing with these solutions the extractive matter is completely removed from the filter-paper and crystals of morphia." And continues, "The thorough washing with 'morphiated spirit' which I employ takes out these substances, and the subsequent treatment with 'morphiated water' removes those insoluble in alcohol, so that the chief impurity present in the crystals of morphia obtained by my modification of the process is meconate of lime, together with some organic matters insoluble in water and alcohol."

Our author now proceeds to what in his summary he terms "the purification of the morphia," by treating the impure precipitate with hot alcohol, and washing with the same. "Dry and weigh the insoluble, which is to be subtracted from the first weight of the precipitate, to get the amount of morphia present"; that is, he regards the whole of this precipitate soluble in alcohol as being pure morphia! unmindful of the fact that all the numerous opium derivatives are equally soluble in hot alcohol. Had he adopted the use of benzene from the late Mr. Teschemacher he would have escaped this danger, as morphia alone of the opium derivatives is insoluble in benzene, excepting narceia, which, however, seems to be soluble in some one of our reagents,—possibly the morphiated water. We may here interpolate a test experiment on this point:—

200 grains of opium (with 50 grains alcohol)	= 9·65 p.c. morphia.
The same repeated	= 9·65 ,, ,,
The same, with 4·50 grains of narcein dissolved in muriatic acid added	= 9·77 ,, ,,

This 0·12 per cent excess may be disregarded.

Mr. Stillwell does not instance any results of his process, whether with or without the use of our morphiated water or spirit. Let us supply this omission, with the amount of morphia we obtained, chiefly during last summer, when examining Mr. Stillwell's process to determine its trustworthiness.

From 5 Samples of Opium—	F.	G.	H.	I.	K.
Stillwell's process exactly followed yielded p.c. of morphia..	8·51	8·40	9·940	8·40	9·55
Teschemacher - Smith process yielded p.c. of morphia..	9·64	9·40	10·60	9·40	11·20

So that in practised hands Mr. Stillwell's process, with five different samples, invariably yielded results lower than our method, being a sum of 44·80 of morphia against 50·24 with ours, and involving a loss of more than 10 lbs. on every 100 lbs. of morphia,—no trifle this.

Observation has forced upon us the conviction that the use of alcohol in morphia processes, beyond a most limited quantity, is incompatible with any reliance on the results obtained. We find that morphia is soluble to the extent of 1·88 parts to 1000 of ether-alcohol, and we think it would dissolve far more in crude opium solutions, where glucosides are present: this invalidates Flückiger's process. It is also an obstacle to the crystallisation and deposit of all the morphia when alcohol is present to any extent. Yet if none is used, and the morphia precipitated without the presence of alcohol, it becomes most difficult to cleanse in the subsequent filtration and washing.

We hope to be pardoned for subjoining a Table showing the influence of varying quantities of alcohol on the amount of morphia obtained of much significance to the analyst.

TABLE.

Seven equal weighed quantities (each = 200 grains opium) of an extract of opium, 600 measured grains of ether, and 50 grains of solution of ammonia (containing half water and half liquor ammoniæ, sp. gr. 0·880), added to each, and the following amounts of alcohol, gave—

Alcohol added, sp. gr. 0·820.	Weight of Alkaloidal Precipitate.	Weight after treating with Benzene.	Titrated and calculated to pure Cryst. Morphia.
None	34·80	26·60	25·55
50 grains	34·20	26·40	25·55
100 ,,	32·50	25·80	25·10
150 ,,	31·00	24·60	23·65
200 ,,	29·00	23·80	23·15
250 ,,	27·70	22·80	22·20
300 ,,	26·50	22·10	21·25

Thus we think 50 grains is the limit of alcohol to be used.

We now proceed to another and wholly different plan, which, if we understand Mr. Allen aright, was selected,

after much examination and research, by Prof. Prescott, and recommended by him to the Committee of Revision of the United States *Pharmacopœia*. This seemingly is known as the Hager-Jacobsen process. This we followed with the greatest care, using an opium we have largely used in this enquiry, yielding us 11·20 per cent of morphia and 14·50 per cent moisture, but which with the Hager-Jacobsen method—which we are given to understand is much used in the United States—gave us but 9·05 per cent of morphia. One trial, but involving this tremendous loss of 2·15 per cent, was conclusive with us, seeing that about 100 grains of dry opium were extracted with some 1150 grains of water, and the morphia obtained directly by lime and muriate of ammonia from this dilute solution. Now considering that 200 grains of the opium we used in the narceia experiment, extracted by water and reduced to 300 fluid grains, yielded by our method 9·65 per cent of morphia, and repeated also 9·65 per cent, whilst with 700 grains of water it yielded but 8·20 per cent, and with 1100 of water only 7·84 per cent of morphia, it became clear enough what had become of the morphia, and that the solubility of morphia in water—wholly ignored by these gentlemen in the United States—proved absolutely fatal to this process admired and seemingly adopted by Prof. Prescott and others.

We have considered Godeffroy's process. As in the foregoing one of Prescott's, this is quite idle from the amount of water, not to dwell on other faults. Then that of the Austrian *Pharmacopœia*. With this the loss of morphia must be tremendous; with four results the yield of impure morphia is cited as being 4·17, 2·04, 0·253, and 0·30 per cent. E. Merck's process, from the quantities of water and spirit used, let alone other sourcess of loss, must be rejected; whilst a method by v. Peyrer is ineffective, the products being crude morphia, which is regarded as being equal to pure morphia in compensation for the loss of this alkaloid, which we cannot admit. So that out of twenty determinations of morphia by these four methods, with six opiums examined, but two have any pretension to agree, and these two differ 1 per cent. We meet with Flückiger again, who need not detain us further than to quote that "he and others repeatedly obtained 0·433 grm. of morphia from 4 grms. of opium, which from Messrs. Squibb and Stillwell cannot be correct results, and only furnishes us with a further instance of Squibb's Law, that these processes "will give results almost exactly comparable among themselves." Venturini has examined several methods of determining the amount of morphia present in opium. He finds "that most of the methods are unsatisfactory, as giving either too low results or yielding impure morphia," in which opinion we agree.

(To be continued.)

THE ACTION OF SULPHUR VAPOUR ON METALLIC COPPER.

By H. N. WARREN, Research Analyst.

THE general action of sulphur on metallic copper is altogether too well known to require explanation, everyone possessing a scientific knowledge, however slight, being perfectly aware of the reaction which attends a mixture of copper turnings and sulphur; on applying heat, the whole mass becoming converted into copper sulphide. Quite a different phenomenon is observed when the vapour of sulphur is used. Take, for example, a crucible containing about two ounces of molten copper upon the surface of which a piece of brimstone has been thrown; the crucible at the termination of the reaction being allowed to cool is next broken, and the button of apparently cupric sulphide extracted; a slight blow with the hammer, however, at once unveils a button of pure copper surrounded by a wall of cupric sulphide, and penetrated to an extent in accordance with the amount of sulphur employed, the penetration being perfectly equal, the extracted button, at the same time, possessing a complete absence of sulphur when examined. In a second experiment a rod of copper one inch in width was taken, and exposed to a dull red heat only, for the space of half an hour, and to the action of sulphur vapour, being afterwards cooled and examined by breaking the point; it was found to have been almost entirely and equally penetrated, so as to readily admit of the wire remaining to be easily dislodged without breaking the casing of cupric sulphide. The above-mentioned results, however, were only obtained when good commercial copper was used, arsenical copper, or the like, being penetrated unevenly, or generally forming a sulphur regulus with the whole of the remaining copper employed, while copper containing zinc, or bars of brass, were absolutely unaffected unless first rendered liquid according to the former experiment.

Everton Research Laboratory,
18, Albion Street, Everton.

THE CHEMISTRY OF THE ONION AS A FIELD CROP IN AUSTRALIA.

By R. W. EMERSON MACIVOR, F.I.C., F.C.S., F.R.G.S., &c.

IT is remarkable that little or nothing should have been published about the chemistry of the onion as a field crop, and that a complete analysis of the popular vegetable is not to be met with in any standard work of reference. The following short note on the subject, even if incomplete in many respects, may prove interesting, containing as it does the results of an inquiry instituted some years ago in a country where the crop in question thrives to perfection.

The Barwon district in the colony of Victoria is the only part of Australasia where the onion is extensively cultivated as the principal field crop. The soil, climate, and situation are specially favourably to the healthful growth of the plant.

The soil is, for the most part, a chocolate loam of basaltic origin, possessing the depth, porosity, and chemical composition peculiar to its class. In a virgin state it contains sometimes as much as 0·28 per cent of nitrogen and 0·20 per cent of phosphoric acid extractable by hydrochloric acid.

In some places where the soil was naturally poorish the yield of onions does not now reach the average of former years, owing, as experience with different manures would indicate, to the removal in crops and otherwise of the original stores of available nitrogen. Though non-nitrogenous guanos and superphosphates have in a few instances slightly increased the crop, it is found that manures containing nitrogen in the form of sulphate of ammonia or as a constituent of blood guano produce more satisfactory results. The liberal use of superphosphate mixed with sulphate of ammonia has invariably proved more beneficial on the poorer land than superphosphate alone. The largest returns, however, have resulted from the joint use of a fertiliser composed of the sulphates of ammonia and potash and superphosphate. I have known an application of about 4 cwts. per acre of this mixture to more than double the crop when the same quantity of the same superphosphate only slightly increased the yield from an identical soil.

The farmers are of opinion that onions produced by the aid of purely chemical manures keep in good condition for a longer period than those obtained from ground which is naturally "forcing," or which has been recently manured with rich farmyard manure.

It is the practice with some of the farmers to prepare the comparatively "worn-out" soil by manuring with phosphatic guano and sowing a pea crop before again putting in onions. In this way a better yield is obtained

than after another crop of onions. Whether or not this result is in part due to the legume inducing the action of nitrifying ferments by which the inert nitrogen of the soil is rendered available, it is of course impossible to say, but that the onion, in common with other crops, depends upon the soil for its supplies of nitrogen, is in my opinion pretty clear.

The mean composition of air-dried onions grown on unmanured land I found to be as follows:—

Water	894·8
Combustible matter (N = 2·37)..	101·0
Ash	4·2
	1000·0

The total nitrogen and mean composition of the ash show that an average crop of, say, eight tons will remove from an acre—

N	42·48 lbs.
K_2O	29·36 ,,
Na_2O	1·88 ,,
CaO	6·52 ,,
MgO.	2·70 ,,
Fe_2O_3	0·30 ,,
P_2O_5.	10·88 ,,
Cl	0·80 ,,
SO_3	22·90 ,,
SiO_2.	1·72 ,,
	119·54 ,,

The total sulphur in the air-dried onions I found to average 0·051 per cent.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

The subject on which I have been asked to address the Chemical Society is the Range of Molecular Forces, and it will perhaps be well that I should, by way of prelude, explain the meaning which I myself attach to that term.

The investigation of the movements of a group of atoms or molecules is—though far more complex—in some respects similar to the study of the solar system. Newton proved that the sun, the planets, and their satellites behave as if a mutual action at a distance taking place between them modified their motions in accordance with a very simple rule. The wonderful impetus which this rule—the law of gravitation—gave to astronomy has led to many attempts to apply a similar method to molecular dynamics. Newton's law is thus frequently regarded as being only the first term of a more complex expression which, if complete, would—on the hypothesis of action at a distance—give the true law of mutual force between the ultimate particles of matter. The first term expresses all the results of experiment when the distances between the particles are considerable, but is insufficient when they are near together. The investigation of the other terms, which then become important, may be properly spoken of as the study of molecular forces.

Sir William Thomson (*Proc. Roy. Institution*, vol. xi., Part III., p. 483) has indeed expressed the opinion that it is possible that the phenomena of cohesion and others which are ordinarily ascribed to a departure at small distances from the law of gravitation, may not be inconsistent with it. In that case the additional terms are introduced by the attempt to apply a formula founded on the assumed continuity of matter to phenomena which are caused by its "coarse grainedness." Interesting as this suggestion is, it has not been worked out sufficiently to make it easy to translate all that we know of molecular action into language consistent with it. I shall, therefore, adhere to the ordinary usage, and assume that it is probable that a somewhat complex expression is required for the full statement of the law of force between two molecules.

If this formula were fully known, the physical interpretation to be given to it would still be open to discussion. Formerly it would no doubt have been considered sufficient to state as an ultimate fact that the law of the force in play between two molecules varies with the distance, that it is, for instance, attractive when they are far apart, repulsive when they are near together. Now, such a supposition is branded as artificial, but I venture to think that the artificiality is due rather to the acceptance of the hypothesis of action at a distance than to the assumed complication of the law. There are two closely related yet really distinct ways in which an apparent repulsive force may be (in the ordinary sense of the word) explained. It may, as has been the case with centrifugal force, be shown to be an effect of motion and inertia without any abandonment of the theory of action at a distance in the case of the other forces involved. Or it may be explained as a result of the properties of a medium by which matter is surrounded, or of which each atom is a specialised part. If action at a distance is thus reduced to action in proximity, if machinery is imagined adequate to account for the effects which distant bodies produce upon each other, it should explain not only the repulsions but also the attractions, not only molecular elasticity but gravitation.

It is, I believe, sometimes thought* that the next step in the progress of the theory of the constitution of matter will be the assumption of an unexplained attraction only between its ultimate particles, while their elasticity is otherwise accounted for. This explanation of elasticity may or may not involve the hypothesis of a medium extending between the molecules.

If we dispense with it, we must not be content with vague analogies to account for the behaviour of two molecules during an encounter. It is true that a comet coming out of space toward the solar system might and probably would travel round the sun without a collision, but in meteors (Swan) and in gases with non-repelling molecules collisions must take place, and Sir William Thomsom (*Rep. Brit. Ass.*, 1884, 616) has insisted on the fact that the result of such collisions in a gas must be the transformation of energy of translation into energy of vibration, with the spontaneous cooling of the gas as a result. It is precisely because no such effect is observed that the theory of elastic molecules is abandoned.

We are thus driven to suppose that elasticity is due to a repulsion, and, if we refuse to accept the theory of action at a distance, to introduce a medium by which the effect of a repulsion acting at a distance may be produced. It is, however, absurd to accept attraction at a distance, and to refuse to conceive of a repulsion acting under similar circumstances, to admit the one without explanation, and to invent a medium to account for the other. The most pregnant suggestions as to the constitution of matter which have hitherto been made do not proceed on these lines. An unexplained attraction is not assumed between vortex atoms in addition to the effects which follow from the laws of hydrodynamics. If it were necessary to adopt such an hypothesis, the vortex atom theory would evidently be as artificial as that embodied in the bald statement that the law of force changes with the distance from attraction to repulsion. It is perhaps possible that some such hybrid theory might serve as a useful basis for calculation, but from the philosophical standpoint it would not be a whit more conceivable than any other which involves action at a distance. If, then, we are to retain the language of the latter theory in any part of our discussion, it will be convenient and not less accurate to retain it throughout, on the distinct understanding that it is a conventional mode of representing facts which we do not fully understand, and which it does not suffice to explain completely. A better method of

* A Lecture delivered before the Chemical Society Feb. 2, 1888.

* "On the Law of Molecular Force," by W. Sutherland, *Phil. Mag.*, July, 1887, p. 127.

expression may be found when suggestions like the vortex-atom theory of Sir William Thomson and the granular theory of Prof. Osborne Reynolds (*Phil. Mag.*, December, 1885) are worked out. They, no doubt, will present grave difficulties as to the true nature of the action in proximity which takes place between contiguous granules, or between neighbouring layers of the ideal fluid in which the vortices are formed, but they will be justified as working hypotheses if they reduce the difficulties connected with the explanation of a large number of physical phenomena under a few heads.

If, then, we use provisionally the language of action at a distance in the expectation that it will ultimately be replaced by a theory of action in proximity, I think we ought, from the first, to admit that the law of force between molecules may be very complicated. We must not dismiss any idea which experiment suggests—such, for instance, as that there are several alternations of attraction and repulsion between two molecules as the distance between them diminishes—merely because it appears arbitrary and lacking in simplicity. It may be admitted, for the sake of argument, that we naturally look for simplicity in our fundamental assumptions; but if the machinery by which distant bodies affect each other, if the medium by which force is transmitted is simple, it by no means follows that its effects on matter can be expressed, on the action at a distance hypothesis by an easy formula. Even in the case of a single ball moving through a perfect liquid bounded by an infinite plane, it will be apparently attracted to or repelled by the boundary according as it is projected parallel to or towards it. In the vortex atom theory the behaviour of two molecules during an encounter would depend entirely upon the circumstances of the collision, and cannot be very shortly described. In the important case of a single vortex ring passing by a large number of others uniformly distributed, it will experience a repulsion.* In Prof. Osborne Reynolds's granular theory two molecules would exhibit mutual attraction and repulsion at different distances. In none of these cases can the fundamental assumptions be regarded as complicated, yet they all give rise to repulsions as well as attractions. They do not lead to simple expressions for the forces in play between molecules separated by distances of the same order of magnitude as the diameters. It would be perhaps too much to say that a simple result could only be produced by a medium of complicated constitutions, but it is certainly true that we have *à priori* no more right to expect simplicity in the results of its action than simplcity in its constitution, and that the two are not necessarily obtained together.

Thus much it has been needful to say in order to explain the point of view from which I wish to regard molecular forces in this lecture. I shall use the language of the action at a distance theory throughout, not—as I hope I have made clear—because I believe in it, but because, in so far as it can express them at all, it affords a self-consistent method of describing facts, the causes of which are as yet imperfectly understood. I shall not discuss the question of the representation of the forces by an algebraical formula. I cannot in the short time at my disposal exhaust the more limited subject to which I intend to confine myself. I desire only to lay before you an outline of the results of the principal experiments which have been made with the view of determining the distances through which a law of force apparently different to that of gravitation obtains. The greatest distance from a molecule at which this deviation is sensible is called "the radius of molecular action." It constitutes the superior limit to the range of molecular forces. The inferior limit is what is ordinarily called the radius of a molecule, but which, if we regard the molecules as exercising when in close proximity a mutual repulsion, is a length related to half the average minimum distance between their centres during an encounter.

This distance may depend on the temperature and on the physical state of the body, so that the diameter of a molecule may be different according as it is determined from experiments on gases or liquids. While retaining it as a convenient phrase, it will emphasize the conventional sense in which it is used if we speak of the diameter of a gaseous or liquid molecule, as the case may be.

Between the limits thus defined the law of force is unknown, though interesting suggestions have been made by Maxwell and others; but apart from this question, which, as I have said, I do not now discuss, the limits themselves may be determined very differently by different methods. The question as to whether a molecular force is "sensible" at a given distance from the molecule, depends partly upon the sensitiveness of the means used to detect it, and partly upon the nature of the phenomenon—electrical, optical, or otherwise—studied. It is impossible, therefore, to group the results of various observations into a connected whole, but it may nevertheless be useful to give a short *résumé* of the conclusions to which different observers have been led, and to attempt to arrange them, as far as may be, in order.

The largest values which have been obtained for the magnitude of the radius of molecular action have been deduced from observations on the condensation of films of gases and vapours on the surfaces of solids. Quincke (*Pog. Ann.*, cviii., 326, 1859) in 1859 argued that if it be assumed that the law of molecular force is the same for molecules in the gaseous, liquid, and solid states, the superior specific gravity of a solid would enable it to condense a gas upon its surface.

It is evident, however, from recent observations, that the nature of the solid is of even greater importance than its density. Among the more remarkable investigations on this point is that of Bunsen (*Wied. Ann.*, xx., 552, 1883). A bundle of glass threads, the total surface of which was determined by preliminary observations and calculations, was enclosed in a chamber connected with a long tube, the lower end of which was dipped in mercury. The gradual rise of the mercurial column showed that an apparent absorption of carbonic acid by the glass was still going on at the end of three years. Later observations (*Wied. Ann.*, xxiv., 1885, 322) proved that although the glass had been carefully dried, it is impossible to get rid of all the adhering moisture, unless the temperature is raised to a point not far short of the critical temperature of water. If this precaution has been omitted, carbonic acid, if present, will, according to Bunsen, be dissolved in the water-film, and since the inner layers of the liquid are subjected by molecular attraction to a pressure which is measured by hundreds of atmospheres, they are capable of absorbing enormous quantities of the gas. The strong acid thus formed appears to attack the glass, and it was found that nearly 6 per cent of the total mass of glass threads employed had been disintegrated (*Wied. Ann.*, xxix., 1886, 161). The long-continued apparent condensation was therefore really slow chemical action. Nay, more, when the glass had been dried at a high temperature, no appreciable condensations of carbonic acid on the surface took place in eight days (*Wied. Ann.*, xxiv., 1885, 335). A small quantity of water was then introduced and absorbed by the glass threads with a rapidity which showed that when really dry they acted as a more powerful desiccator than calcium chloride. Immediately after the introduction of the water the absorption of the CO_2 began as before, which proved that moisture was necessary to produce the phenomenon, or that carbonic acid does not condense to a measurable amount on dry glass.

By exposing glass threads to a series of constant temperatures until in each case no more moisture could be extracted by the passage of a current of dry air over them, and by measuring the successive quantities of water

* "Motion of Vortex Rings," J. J. Thomson. Macmillan, 1883, p. 55.

thus obtained, Bunsen was able to calculate the total thickness of the water film, which at each of these temperatures is irremovable by dry air. Under ordinary conditions water does not evaporate when its vapour exerts upon the surface a particular pressure, the magnitude of which varies with the temperature. Any internal layer parallel to the surface is subjected to an additional molecular pressure which increases rapidly with the depth, until the boundary of the superficial portion of the liquid is reached, after which it becomes throughout the interior constant.

If the interior mass of water be replaced by a solid which exerts, *cæteris paribus*, a greater attraction on water than that of water itself, the molecular pressure would be increased, and thus the vapour-tension might be diminished without evaporation taking place. The defect of the external pressure would be balanced by the increased molecular attraction. If, then, we assume that the thickness of the water film which cannot at any given temperature be removed by dry air is such that the pressure due to molecular attraction at the surface of the film is equal to the pressure of aqueous vapour at the temperature at which the experiment is made, it is possible when the vapour-tension is known to calculate the molecular pressure for given thicknesses of the film. The following table expresses Bunsen's results. The temperature is expressed in degrees centigrade. The thickness, neglecting some minor corrections, is indicated by D, and expressed in terms of micromillimetres ($\mu.\mu.$)* The pressure is expressed in atmospheres :—

t.	D.	*p.*
23°	10·52	0·027
107	6·70	1·278
215	5·47	20·791
329	3·63	—
415	1·32	—
468	0·42	—
503	0·00	—

If the desiccation with dry air was incomplete the thickness of the films very much exceeded the above limits. Thus in one experiment, in which the drying was purposely imperfect, the water layer was 232·4 $\mu.\mu.$ thick. The interpretation to be placed on these results has, however, been again rendered doubtful by the experiments of Warburg and Ihmori (*Wied. Ann.*, xxvii., 481, 1886). These observers constructed a small balance of extraordinary delicacy, which was enclosed in an exhausted receiver, which could be connected at pleasure with vessels containing strong H_2SO_4 or water. When it had been dried by frequent evacuation, water vapour was admitted, and the weight of the films deposited on a thin glass bulb suspended from the balance was determined. They found that if before the experiment the glass was washed with boiling water, the deposited film was very much thinner than if this precaution was omitted. The thickness diminished in two experiments in the proportion of 48 to 4 and 23 to 2. In a third case no film could be detected even when the temperature of the receiver was only 0·2° above the dew point.

Glass rods which have been boiled for a few minutes will not discharge an electroscope, even when they have for long been in a relatively damp atmosphere, under circumstances such that rods of the same glass which have not been similarly treated conduct readily.

The film of moisture adherent to glass may thus be divided into two parts, distinguished as the permanent and temporary respectively, of which the latter disappears under the influence of a long-continued current of dry air, while the former can only be removed by raising the temperature. Warburg and Ihmori conclude that the temporary film (with which they alone deal) is not produced by the molecular attraction of the glass as a whole on water vapour. They refer to experiments which prove that if glass powder be boiled in water measurable quantities of alkali are dissolved. They therefore assume that there is a certain quantity of free or loosely combined alkali on the surface of the glass, and that it absorbs water until a solution is formed, the vapour-tension of which corresponds to the hygrometric state of the air in the neighbourhood. If carbonic acid is then absorbed by the solution, the glass may be attacked and the process continued.

(To be continued).

* The micromillimetre is the millionth part of a millimetre.

METHODS OF MILK ANALYSIS.*

Estimation of Water.

From a weighing bottle take 5 c.c. milk, put in a weighed thin glass dish, or dish lined with tinfoil, one-third full of powdered asbestos ; dry for two hours at 100° C. The temperature obtained in a boiling water-bath does not reach 100° C. The milk should be dried in an air-bath, the temperature of which is carefully controlled.

Alternate Method of Estimating Water.

Evaporate one or two grms. of milk in shallow watch glass or platinum dish on the water-bath for thirty minutes. Dry for an hour at 100° C. and weigh.

Estimation of Casein.

Take 5 grms. of milk, digest in Kjeldahl apparatus, with 20 c.c. H_2SO_4, and estimate ammonia in the usual way.

Alternate Method of Estimation of Casein.

Rub up in a mortar the thin dish containing the dried residue from the above process or remove the foil containing it, and transfer to soda-lime combustion tube in the usual way.

The mortar and pestle must be well cleaned with the soda-lime and these cleanings placed in the tube.

Or the dish or tinfoil and its contents may be transferred to a digestion flask and the casein estimated by the method of Kjeldahl.

Estimation of Fat.

Method of Adams.—The kind of paper and the method of using it first proposed by Adams are as follows :—

"As for material, the only extra article is some stout white blotting-paper, known in the trade as 'white demy blotting mill 428,' weighing 38 pounds per ream. This should be in unfolded sheets, machine-cut into strips 2½ inches wide and 22 inches long ; each sheet in this manner cuts into seven strips.

"I have tried other papers, but none have answered so well as this ; it is very porous and just thick enough. Each of these strips is carefully rolled into a helical coil, for which purpose I use a little machine, made by myself, consisting of a stout double wire, cranked twice at right angles, and mounted in a simple frame. One end of the strip being thrust between the two wires, the handle is turned, and the coil made with great facility. This may be done, for the nonce, on a glass rod, the size of a cedar pencil. Two points have to be carefully attended to: the paper must not be broken, and the coil must be somewhat loose, the finished diameter being a little under an inch. I am in the habit of rolling up a considerable number at a time and placing each within a brass ring as it is rolled, inscribing on one corner with a lead-pencil its own proper number.

"These coils are next thoroughly dried, and I need hardly say the accuracy of the process depends upon this drying. This can be satisfactorily done in an ordinary air-bath at 100° C., providing the bath be heated properly

* Official Methods of Analysis of the Association of Official Agricultural Chemists for 1887-88. U.S. Department of Agriculture, Division of Chemistry.

and the paper kept in it long enough. I found the common way of heating the thin bottom of the bath with a single jet not to answer. My bath is placed upon a stout iron surface, which is heated by a large ring of jets; in this way the heat is evenly distributed over the whole of the bottom of the bath, and the papers, which are put in a cage frame of tinned iron wire 5 by 2½ inches and divided into eight partitions, get evenly and completely dried, if allowed to remain in the bath all night, and weighed in a weighing tube next morning, and their weights having been registered according to their numbers, stored away ready for use, as follows:—

"The milk to be examined is shaken, and with a pipette 5 c.c. are discharged into a small beaker 2 inches high by 1¼ diameter, of a capacity of about 30 c.c. weighing about 12 grms. This charged beaker is first weighed, and then a paper coil gently thrust into the milk very nearly to the bottom. In a few minutes the paper sucks up nearly the whole of the milk. The paper is then carefully withdrawn by the dry extremity of the coil and gently reversed, and stood, dry end downwards, on a clean sheet of glass. With a little dexterity all but the last fraction of a drop can be removed from the beaker and got on the paper. The beaker is again weighed, and the milk taken got by difference. It is of importance to take up the whole of the milk from the beaker, as I am disposed to consider the paper has a selective action, removing the watery constituents of the milk by preference over the fat.

"The charged paper is next placed in the water oven on the glass plate milk-end upwards, and rough-dried. Mismanagement may possibly cause a drop to pass down through the coil on to the glass. This accident ought never to occur; but if it does, it is revealed in a moment by inspection of the surface of the glass, and the experiment is thereby lost.

"In about an hour it is rough-dried and in a suitable condition for the extraction of the fat."

The method of Adams has been thoroughly tried by the English chemists, and has received the approval of the English Society of Public Analysts. It gives uniformly about 0·2 per cent more fat in normal milk than the ordinary gravimetric methods.

The following modification of the process may be used:—

"The blotting-paper is replaced by thick filtering paper cut into strips 2 feet long and 2·5 inches wide. These are thoroughly extracted by ether or petroleum ether (or alcohol).

"One end of the strip of paper being held horizontally by a clamp or by an assistant, 5 c.c. milk is run out by a pipette from a weighing bottle along the middle of the strip of filtering paper, being careful not to let the milk get too near the ends of the paper, and to secure an even distribution of it over the whole length of the slip. The pipette is replaced in the weighing bottle and the whole re-weighed, and thus the quantity of milk taken is accurately determined. The strip of paper is now hung up over a sand-bath in an inclosed space high enough to receive it where the air has a temperature of 100° C. (*circa*). In two or three minutes the paper is thoroughly dry. It is at once, while still hot, rolled into a coil and placed, before cooling, in the extraction apparatus already described.

"The fat is dissolved by ether or petroleum, collected in a weighed flask, and, after thorough drying, weighed."

The fat after extraction may also be estimated volumetrically, as described in the method of Morse.

From data which have been collected it appears that the estimation of the fat in milk by the lactrocrite is strictly comparable with the results of the Adams method. Those who have this instrument, therefore, can use it instead of the method given.

Alternate Method of Estimating the Fat in Milk.

Method of Morse, Piggot, and Burton.—This method consists in the dehydration of the milk by means of anhydrous sulphate of copper; the extraction of the fat by means of the low-boiling products of petroleum; the saponification of the butter by means of an excess of a standard solution of potassium hydroxide in alcohol; and the determination of the excess of the alkali by means of a solution of hydrochloric acid. The following apparatus and reagents are required:—

(1) A porcelain mortar and pestle.

(2) An extraction tube, 14 or 15 m.m. in diameter, 220 m.m. in length, with funnel-shaped top. A straight chloride of calcium tube may be used for this.

(3) A 200 c.c. Erlenmeyer flask, strong enough to be used with a filter-pump.

(4) A suitable stand for holding the flask and extraction tube.

(5) Ten c.c. pipettes.

(6) Weighing-glasses with ground-glass stoppers.

(7) A low-boiling gasoline, distilling between 30° and 60°.

(8) Dehydrated sulphate of copper.

(9) Semi-normal solution of potash in 95 per cent alcohol.

(10) A semi-normal solution of hydrochloric acid.

Manipulation.—Place about 20 grms. of the anhydrous copper sulphate, roughly measured in a copper spoon of the size to hold about that amount, in a porcelain mortar; make a cavity in the centre of the mass with the pestle. Allow 10 c.c. of the milk to run on to the copper sulphate, being careful that none of it touches the sides of the mortar. When the milk is nearly dry, grind the mass up with a little clean sand, transfer to the extraction tube, gently pressing it down in the tube by means of a glass rod. The lower portion of the extraction tube to be packed with clean cotton-wool. The fat is extracted in the following way:—15 c.c. of benzine are poured over the material in the extraction tube and drawn down with the aid of the filter-pump, until the whole of the mass to be extracted has become wet with the liquid, when the connection with the pump is closed; after about five minutes another portion of 15 c.c. of benzine is poured into the tube, and the whole of the liquid slowly drawn through with aid of the pump into the flask. Usually one extraction of this kind is sufficient to withdraw the whole of the butter, but for the sake of greater accuracy the process may be repeated two or three times.

Titration.—The benzine may be evaporated and the residual butter fat saponified with about 25 c.c. of the approximately semi-normal potash. The residual alkali is determined by means of the semi-normal hydrochloric acid, using phenol-phthalein as indicator. The difference between the amount required in this process and the amount necessary to neutralise the quantity of alkali taken gives the amount of alkali required for the saponification. The number of milligrms. of potash required for one grm. of the fat is taken at 230. The fat may also be accurately titrated without evaporating the benzine.

Alternate Method of Estimating Water and Fat in Milk.

Method of Babcock.—In the bottom of a perforated test-tube is placed a clump of clean cotton; the tube is then filled three-quarters full of ignited asbestos, lightly packed, and a plug of cotton inserted over it. The tube and contents are weighed and the plug of cotton carefully removed, and 5 grms. of milk from a weighed pipette run into it, and the plug of cotton replaced. The tube connected at its lower end by a rubber tube and adapter with a filter-pump is placed in a drying oven of a 100° C., and a slow current of dry air drawn through it until the water is completely expelled, which in no case requires more than two hours.

The tube containing the solids from the above operation is placed in an extraction apparatus and exhausted with ether in the usual way.

Alternate Method of Estimating Water and Fat.

Method of Professor Macfarlane.—A glass tube 4 to 5 c.c. in length and 2 c.m. in diameter, open at one end,

drawn out to a tube 5 m.m. in diameter at the other end, is two-thirds filled with asbestos fibre, such as is used in manufacturing packing. It is dried in the water-bath for several hours, cooled in the desiccator, and weighed. Ten c.c. of the milk is then added from a pipette, which is completely absorbed by the asbestos. It is then weighed, the additional weight of the milk representing the amount taken. The tube, along with many others, is placed in a water-bath with constant level and dried for ten or twelve hours (during the night) at a temperature of 90°. Next morning the tubes are cooled in the desiccator and weighed, the loss in weight being the moisture. The tubes are then placed in the Soxhlet extraction apparatus and exhausted with petroleum ether for four hours. They are then removed and dried in a steam-bath, cooled in desiccator, and weighed. The loss represents the butter fat.

The Estimation of Sugar.

The reagents, apparatus, and manipulation necessary to give the most reliable results in milk-sugar estimation are as follows :—

Reagents.—(1) *Basic plumbic acetate*, sp. gr. 1·97. Boil a saturated solution of sugar of lead with an excess of litharge, and make it of the strength indicated above. One c.c. of this will precipitate the albumens in 50 to 60 c.c. of milk.

(2) *Acid Mercuric Nitrate.* Dissolve mercury in double its weight of nitric acid, sp. gr. 1·42. Add to the solution an equal volume of water. One c.c. of this reagent is sufficient for the quantity of milk mentioned above. Larger quantities can be used without affecting the results of polarisation.

(3) *Mercuric Iodide with Acetic Acid.* KI 33·2 grms., $HgCl_2$ 13·5 grms., H, C_2H_3O 20 c.c., H_2O 64 c.c.

Apparatus.—(1) Pipettes marked at 59·5, 60, and 60·5 c.c. (2) Sugar flasks marked at 102·4 c.c. (3) Filters, observation tubes, and polariscope. (4) Specific gravity spindle and cylinder. (5) Thermometers.

Manipulation.—(1) The room and milk should be kept at a constant temperature. It is not important that the temperature should be any given degree. The work can be carried on equally well at 15° C., 20° C., or 25° C. The slight variations in rotatory power within the above limits will not affect the result for analytical purposes. The temperature selected should be the one which is most easily kept constant.

(2) The specific gravity of the milk is determined. For general work this is done by a delicate specific gravity spindle. Where greater accuracy is required use specific gravity flask.

(3) If the specific gravity be 1·026, or nearly so, measure out 60·5 c.c. into the sugar flask. Add 1 c.c. of mercuric nitrate solution or 30 c.c. mercuric iodide solution and fill to 100·4 c.c. mark. The precipitated albumen occupies a volume of about 2·44 c.c. Hence the milk solution is really 100 c.c. If the specific gravity is 1·030 use 60 c.c. of milk. If specific gravity is 1·034 use 59·5 c.c. of milk.

(4) Fill up to mark in 102·4 c.c. flask, shake well, filter, and polarise.

Notes.—In the above method of analysis the specific rotatory power of milk sugar is taken at 52·5, and the weight of it in 100 c.c. solution to read 100 degrees in the cane-sugar scale at 20·56 grms. This is for instruments requiring 16·19 grms. sucrose to produce a rotation of 100 sugar degrees. It will be easy to calculate the number for milk-sugar whatever instrument is employed.

Since the quantity of milk taken is three times 20·56 grms., the polariscopic readings divided by 3 give at once the percentage of milk-sugar when a 200 m.m. tube is used.

If a 400 m.m. tube is employed, divide reading by 6; if a 500 m.m. tube is used divide by 7·5.

Since it requires but little more time, it is advisable to make the analysis in duplicate, and take four readings for each tube. By following this method gross errors of observation are detected and avoided.

By using a flask graduated at 102·4 for 60 c.c. no correction for volume of precipitated casein need be made. In no case is it necessary to heat the sample before polarising.

In the above method no account is taken of the fat which is retained on the filter with the casein. It is worth while to enquire if a correction similar to that made for the abumenoids should not also be made for the fat ?

Estimation of Ash.

Evaporate to dryness in a weighed platinum dish 20 c.c. of milk from a weighing bottle, to which 6 c.c. of HNO_3 has been added, and burn in a muffle at low red heat until ash is free from carbon.

NOTICES OF BOOKS.

Management of Accumulators and Private Light Installations. A Practical Handbook. By Sir David Salomons, Bart., M.A., M.S.T.E. Third Edition, Revised and Enlarged. London: Whittaker and Co., Paternoster Square.

The two earlier editions of this work seem to have been issued under another title. The subject-matter of the present edition has been re-written so as to bring the subject down to date.

The work consists of two parts. The first, dealing with cells, describes their mode of employment, the setting up of the battery and the management of the accumulator-house, the processes of charging and discharging, the causes of failures and their remedies, followed by a general summary.

The second part is devoted to installation work and practice, and includes sections on dynamos, engines and electrical-motors, switch-boards, switches, instruments, lamps and wiring, the action of cells with the dynamo, methods of working and governors, estimates of the expense necessary for electric lighting, and, lastly, an account of the installation at the author's residence. We notice one remark not easy to understand :—"If the engine-house is made totally inflammable there is no necessity to insure against fire."

We find that at the author's mansion the cost of the electric light was at the rate of 2*d.* per hour for every 16-candle power lamp. In 1885 the cost was reduced to $1\frac{1}{4}d.$ per hour, and in 1886 $\frac{1}{7}d.$ per hour, for each lamp of the same power. In this year the electric light proved therefore cheaper than gas, supposing it to be sold at 3*s.* 6*d.* per 1000 cubic feet. The first outlay is considerable, and for a small house, not connected with any public supply of electric energy, would be simply prohibitive. But for large manufacturing establisments the estimates here given will prove a valuable guide. The "Management of Accumulators" will prove exceedingly useful for persons who contemplate erecting an electric light installation for their own premises.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Mr. Lovett has been for some years a Fellow of the Institute, and it is to be presumed has in his possession some, if not all, of the numerous presidential addresses which have been printed and circulated. A perusal of these should have given him the information he asks me to supply, but if, considering these out of date, he will

wait for a few days, he will have a most lucid treatise on the aims and intentions, hopes and aspirations, of our body, in the shape of the admirable address read by Dr. Odling on Thursday last.

In my opinion the Institute has already achieved a work of immense value not only to the profession as a whole, whether within or without its bounds, but to the nation, inasmuch as it has given the science, as applied to the practical needs of life, a corporate existence, a voice, and the means of making its voice heard.

This is now an accomplished fact; in place of a scattered and unrecognised body—a sort of poor relations of the medical men, not even on a level with pharmacists, and immeasurably below engineers or architects in public estimation—there has come into being a compact, organised, and comparatively wealthy corporation, recognised by the Government, and able and willing to make its influence felt in the world.

Surely we should be content with so much effected in eleven years (most of us thought twenty not too much to allow for the work) and not let ourselves, simply because things are tranquil, be bitten with that spirit of "*must do something*," which Herbert Spencer has indicated as the cause of so many miscarriages of well-intentioned effort.

Above all, we should seek for advance in general service for the common good, and keep in the background as much as we can that question of "What do I, Smith, get for my guinea to distinguish me from Robinson, who keeps his in his pocket?" For those who adopt this attitude a sufficient answer is: "The self-glorification consequent upon permission to use the letters F.I.C.!" I am, &c.,

R. J. FRISWELL.

115, Darenth Road, N.,
March 4, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 7, February 13, 1888.

An Ancient Process for Rendering Jewels and Vitrifications Phosphorescent.— M. Berthelot.—The collection of the Greek alchemists found in certain MSS. of the 13th and 15th centuries in the National Library, describes processes used for the artificial colouration of factitious jewels, emeralds, carbuncles, and hyacinths. Stones were to be made luminous in the night by dyeing them with a mixture of copper rust and of the gall of the tortoise. A finer colour was obtained by using the sea medusa instead of the tortoise. This colouration was of course not permanent, but it was easily reproduced.

In What Degree of Oxidation are Chrome and Manganese in their Fluorescent Compounds.—Lecoq de Boisbaudran.—The author does does not answer this question.

The Absorbent Power of Soils in the Formation of Native Sodium Carbonates.—Paul de Mondesir.—Berthollet's explanation of the formation of soda in as far as common salt yields the soda and calcium carbonate the carbonic acid. But the reaction occurs in two stages; in the former the soil reacts upon the sodium chloride, converts it into calcium chloride by giving it lime and absorbing soda. In the second phase, which sets in only after the removal of the calcium chloride, the calcium bicarbonate and the carbonic acid cause soda to issue from the earth by giving lime to the latter. Sodium carbonate is produced in all permeable calcareous soils according to the quantity of sodium chloride which they receive.

On Chemical Equilibria.—P. Duhem.—The author shows that the conclusion of a memoir by M. Le Chatelier (*Comptes Rendus*, cvi., p. 355) is anticipated in his paper to be found in the *Comptes Rendus* (xcix., p. 1113).

The Mineralising Action of Alkaline Sulphides: Reproduction of Cymophane.—P. Hautefeuille and A. Perrey.—By this agency the authors have effected the crystallisation of glucina, its separation from alumina, or, inversely, the reproduction of the aluminate of glucina, a compound met with in Nature, and known as cymophane.

Displacement of Copper by Zinc in certain Solutions of the Copper Salts.—A. Destrem.—If copper is thrown down from its solutions by means of a slip of pure, clean zinc, the deposit varies in colour according to the salt of copper present. With the sulphate and nitrate the deposit is slightly adhesive, pulverulent, and of a maroon or blackish colour. In slightly alkaline solutions, such as ammonium cupro-sulphate, the deposit is red and perfectly adhesive. In the salts of the weaker acids the coating is of a brassy yellow, and strongly adhesive. In neutral or slightly alkaline solutions there are formed, at the outset, alloys possessing the composition of brasses. Similar phenomena are observed with cadmium.

The Splitting-up of Chloroform by Alcoholic Potassa, and its Determination by means of this Reaction.—L. de Saint-Marten.—Potassa dissolved in alcohol, of 60 per cent, at the temperature of 100°, completely splits up chloroform into potassium formiate and chloride. The quantity of chloroform originally present is deduced from the chlorine.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 3.

Dryness of Walls, &c.—J. Nessler.—The author lays a very thin slip of gelatin against the object. If this is not thoroughly air-dry the gelatin becomes curved, with its convexity towards the object.—(*Chemiker Zeitung*).

Presence of Soluble "Weighting" Ingredients in Leather.— B. Kohnstein.— The author takes 20 to 25 grms. of the sample, finely shred, determines moisture at 100°, lixiviates three or four times with lukewarm water until the extracts no longer appear coloured, filters, and makes up the total extract to ½ litre. Of this liquid 100 c.c. are evaporated down and the dried residue is weighed. This shows the sum of all extracted matters, tannin, colouring-matters, gallic acid, and other extractive matters of the tanning agents, and if present, sugar, dextrine, and extractive substances from the weighting materials. This residue is incinerated. To determine tannin, colouring-matter, and gallic acid, 200 c.c. of the extract are mixed with 6 grms. of recently ignited magnesium oxide and let stand, shaking frequently, until the clear liquid no longer reacts either with iron or glue. In this manner the tannin, colouring-matter, and gallic acid are precipitated, everything else remaining in solution. The liquid is filtered, an aliquot part of the clear filtrate is evaporated to dryness, weighed, and the amount of ash determined. The difference between the former percentage of dry matter free from ash and this latter result shows the total percentage of tannin, colouring-matter, and gallic acid.

Determination of the Decolourising Power of Bone-black.—G. Laube.—Five grms. of normal black are heated to a boil in a capacious flask with 200 c.c. of water, 10 c.c. of colour solution are added, and the whole is kept at a gentle boil for ten minutes, preventing the loss of water by means of a reflux condenser. The liquid is then at once filtered through a double folded filter. We then add to 200 c.c. of water, colour solution from a measuring pipette until the liquid has exactly the same tint as the above filtrate. If 2·1 c.c. of colour solution

have been used in one experiment 10 − 2·1 = 7·9 c.c. of colour solution have been absorbed by the standard bone-black. The sample to be tested is then treated in a similar manner. The standard and the sample must both be sifted through a sieve of the same fineness.

Determination of Rich Copper Ores.—E. Donath and R. Jeller.—A portion of the ore in fine powder is thoroughly mixed in a porcelain capsule with twice its volume of zinc-powder, and then ignited for ten minutes in a covered crucible. The contents are then boiled in a small beaker in an excess of dilute sulphuric acid (1 part acid with 3 to 4 parts water), when the zinc sulphide, the excess of zinc, and the reduced iron dissolve. The copper remains as such accompanied by the gangue, and any metals precipitable by zinc. After washing the copper sponge by decantation with hot water it is dissolved in dilute nitric acid with the aid of heat, the gangue is filtered off, and an aliquot part of the solution is titrated with potassium cyanide in an ammoniacal solution.

Simplified Method for Determining Carbon in Arable Soil.—G. Gustavson.—About 5 grms. soil are put in a platinum boat and introduced into a tube of sparingly fusible glass 50 c.m. in length; the other part of the tube receives a layer of scaly copper oxide 10 c.m. in length, between asbestos plugs. This part of the tube is enfolded in copper-wire gauze and heated by a burner. The organic matter is slowly burnt in the current of oxygen by means of a second burner. The boat must be heated slowly at the beginning of the operation. The sulphuric acid through which the gases pass must remain colourless, and the carbonic acid is collected in the ordinary manner.

Rapid Examination of Alloys of Lead and Tin.—Fœhr.—The proportions of the metals are calculated from the specific gravity of the alloy by means of a table which the author has drawn up.

Impurity in Chloroform. — L. Scholvein. — The author found in several cases an impurity of arsenic present, apparently derived from impure arsenical sulphuric acid used in the purification of the chloroform.

Valuation of Coca Leaves.— Kœhler. — From the *Pharmaceutische Zeitung.*

Detection of Codeine in Morphine Hydrochlorate.—H. Hager.—0·1 grm. of the sample is dissolved in 2 c.c. of water; 3 drops of the warm solution are placed upon a large object glass and spread out to the size of a shilling. In the centre of this is placed a drop of soda-lye of sp. gr. 1·16, when a turbidity occurs in from one to five seconds. For the detection of narcotine Hager proceeds as above, but adds 5 or 6 drops of soda-lye and stirs up with a glass rod. If only codeine is present as an impurity the mixture remains clear and transparent, but if narcotine is present a white turbidity is at once formed and does not disappear.

Determination of Oxalic Acid in Urine.—O. Nickel.—Neither the method of Schultzen and Neubauer nor any of its many modifications can be considered satisfactory.

New Apparatus for Determining Urea with Bromine-water.—C. Frutiger.—This apparatus cannot be intelligible described without the accompanying cut.

Determination of Creatinine in Urine.—P. Grocco.—The author makes use of Neubauer's process. To prevent the conversion of creatinine into creatine he keeps the sample in ice and adds acetic acid.

Determination of Hippuric Acid in Urine. — O. Völker.—For the author's process we must refer to the original.

The Application of the Sugar Tests of Molisch to Urine.—A controversy between Molisch and Seegen.

Determination of Sugar in Diabetic Urine and the Reductive Power of Normal Urine.—J. Munk.—The reductive value of normal human urine equals, on an average, 0·3 per cent of sugar. The use of carbohydrates does not affect the proportion.

Detection of Phenol.—Dragendorff.—In toxicological cases the author, instead of distilling with sulphuric acid, shakes the mixture out with petroleum ether.

Behaviour of Thalline and Antipyrine.—E. Blumenbach.—The author describes the methods of extracting these bases from mixtures and organs, and their most available tests.

The Atomic Weight of Antimony.—F. Pfeiffer and A. Popper.—These authors have proceeded by the electrolysis of a solution of antimonious chloride, and have obtained the values 120·72, 120·82, and 120·54, figures which are a unit higher than the value found by Cooke.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. Series 4, Vol. ii., No. 23, Nov., 1887.

Inauguration of the Statue of Nicolas Leblanc.—This ceremony took place on June 28th last, when discourses in honour of the deceased inventor were pronounced by M. E. Peligot, representing the Academy of Sciences, by the Minister of Commerce and Industry, and by Colonel Laussedat.

On Sewage.—Dr. Meymott Tidy.—A discourse delivered before the Chemical Society.

No. 24, December, 1887.

Copper Assays in the Mineral Market.—Mr. Westmoreland.

Improvement in the Manufacture of Sodium.—J. Mactear.—Both these papers are from the *Journal of the Society of Chemical Industry.*

Revue Universelle des Mines et de la Metallurgie. Series 3, Vol. i., No. 1, January, 1888.

This issue contains no chemical matter.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Bleaching Soft Soap.—Can a soft soap be bleached, or is it possible to make a white soft soap; and if so, how is it made, and should I infringe a patent by making it?—T. R.

MEETINGS FOR THE WEEK.

MONDAY, 12th.—Medical, 8.30.
—— Society of Arts, 8. "Alloys," by Prof. W. Chandler Roberts-Austen, F.R.S.
TUESDAY, 13th.—Royal Medical and Chirurgical, 8.30.
—— Institution of Civil Engineers, 8.
—— Photographic, 8.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
WEDNESDAY, 14th.—Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
—— Society of Arts, 8. "Agricultural Education and Dairy Instruction," by Professor John Wrightson.
THURSDAY, 15th.—Royal, 4.30.
—— Royal Institution, 3. "Microscopical Work with Recent Lenses on the Least and Simplest Forms of Life," by The Rev. W. H. Dallinger, LL.D., F.R.S.
—— Chemical, 8. Ballot for the Election of Fellows. "The Nature of Solution as Elucidated by the Heat Evolved on Diluting Solutions. Part. I: Calcium Chloride."
FRIDAY, 16th.—Society of Arts, 8. "The Origin, Progress, and Influence of Universities in India," by F. J. Mouat, M.D.
— Royal Institution, 9 "The Structure, Origin, and Distribution of Coral Reefs and Islands," by John Murray.
SATURDAY, 17th.—Royal Institution, 3. "The Modern Drama: Scandinavian," by William Archer.
—— Society of Arts, 8. "Protection of Buildings from Lightning," by Professor J. Oliver Lodge.

THE CHEMICAL NEWS.

VOL. LVII. No. 1477.

ON THE

DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

(Concluded from p. 95).

WE think it useless to pass in review any more of these methods of dealing with opium, for until my late friend and partner, Edward Teschemacher, had devised his method, the writer had habitually declined undertaking opiums, for the best of all reasons—that he knew no method of estimating the morphia they might contain which could be relied on.

It would be, on very many accounts, most objectionable were we to pass unnoticed the important process of the *British Pharmacopœia*. We have not the first edition (1867), although we find in Mr. Squire's "Companion to the British Pharmacopœia" (pp. 224-5, ed. 13th) a full description of the process for estimating the morphia in opium; and this we have followed with great exactness, using an opium we have frequently employed in this research, yieding to us 11·20 per cent of morphia, and obtaining by this method of the *British Pharmacopœia* 2¾ and 3¾ per cent of morphia for the results of two experiments. We should have further investigated this matter had we not found that the process had been superseded in the more recent edition of 1885, convincing us that the former mode had been found to be faulty, and so withdrawn.

This brings us to the article "Opium," pp. 295-7 of the *Brit. Pharm.* (1885). We have been tempted to criticise this article apart from the process for the determination of morphia,—a temptation we have resisted as foreign to the immediate object of this pamphlet, although we shall be forced to indulge in some few remarks which are germane to the process.

Process.—Triturate together 140 grains of dry opium, 60 grains of slaked lime, and 400 grains of water until a uniform mixture results. Then add 1000 more grains of distilled water, stirring occasionally during half an hour. Now "filter this mixture into a wide-mouthed 6 oz. bottle marked at exactly 1040 grains, until it reaches this mark. To the filtered liquid (representing 100 grains of opium) add 110 grains of rectified spirit and 500 of ether, shake the mixture, and then add the chloride of ammonium"; with further instructions most minutely detailed, concluding with the "crystals, morphia, should not weigh less than 9½ grains and not more than 10½ grains, corresponding to about 10 per cent of morphia in the dry opium." This formula presented great difficulties to us who wished to follow it with absolute exactness. Why 1040 grains of the liquid were to be regarded as equal to 100 grains of opium instead of 1000 grains of the filtrate we could not then, nor can we yet, understand. Then, as we could not pretend to use, with any hope of exactness, such a measure as "a 6-oz. wide-mouthed bottle marked exactly at 1040 measured grains," we fell back on our usual apparatus for this purpose.

This process of the *British Pharmacopœia* of 1885 is, in our view, by far the most important to the dealers in opium in this kingdom of any of the processes for determining the morphia present in opium we have considered or met with. It comes to us claiming respect, and seemingly entitled to exact it. The *Brit. Pharm.* is stamped "By Authority." "Pursuant to the Medical Act, 1858." It has been compiled by three editors, who are professors to boot, seemingly with the guidance and sanction of physicians of rank and standing. Thus it may claim to possess legal authority also, and be appealed to, on any question which may arise connected with the subject of which it treats, and its authority accepted by a Court of Law as determining, and determining finally, any such question. Thus, whilst compelled to point out some two or three questionable directions in this opium process of the *Brit. Pharm.*, we have followed its directions when possible,—as in taking 1040 fluid grains of the filtrate, and only declining its somewhat rude apparatus for measuring these, as it did not admit of being used twice successfully, if ever.

We have employed this method in six different trials, with the subjoined results, using an opium constantly giving us 11·20 per cent of morphia.

No. 1	yielded	9·60	per cent	of morphia.
2	,,	10·50	,,	,,
3	,,	9·60	,,	,,
4	,,	9·60	,,	,,
5	,,	9·40	,,	,,
6	,,	9·40	,,	,,

Experiment "No. 2, 10·50 per cent of morphia," is the only doubtful result. No approximation to this occurred in either of the four subsequent tests, and thus we incline to assign this one to some error of analysis, and dismiss it from consideration as usual in such cases.

The crushing conclusion remains that a process which ought to be trustworthy signally fails when put to the proof by probably the most practised hands in the kingdom. It has yielded 9·40 to 9·60 per cent of morphia with an opium which has, over and over again, afforded us 11·20 per cent. Moreover, whilst we are very sure that our 11·20 per cent is pure morphia, we have no such conviction, but rather grave doubts, whether the *Pharmacopœia* method yields, or is expected to yield, pure morphia. If so, whence that odd provision of a margin of "9½ to 10½ grains"?—*i.e.*, a difference of some 10 per cent in the results, permitted, probably expected.

We have not seen the Medical Act of 1858, but we should be amazed to find that such a matter as this opium process was an instruction therein, and therefore, if it were not requisite, we are still more amazed to find that a triple editorial staff did not suffice to cancel an imperfect process and suppress it altogether. Here the Squibb law, that results may be obtained "almost exactly comparable among themselves," is again true, five tests yielding from 9·40 to 9·60 per cent of morphia, so that a faulty method, involving grave sources of error, is adopted by authority.

Our own experience with opium has long led us to distrust the use of lime, which the *Pharmacopœia* authorities have employed in both their editions. This use of lime is open to many objections, an obvious one being that as sal-ammoniac precipitates lime when added to such a solution as yielded by the *Pharmacopœia* process, and the precipitate is washed with distilled water, this water will dissolve the lime, which, in its turn, will dissolve the morphia, and thus be one cause of the large loss of morphia involved in the use of this process of the *British Pharmacopœia*.

Before we finally take leave of Mr. Allen and his useful book on the Alkaloids, he will doubtless allow us to state that we look upon morphia as being insoluble in benzene; that we find, experimentally, the evaporation of solutions of morphia at a moderate heat,—that of a water-bath,—involves no tendency to decompose the morphia; that we have no reason to think that any morphia remains dissolved in the morphia liquor, seeing that we wash with "morphiated spirits" and "morphiated water"; whilst we defeat any objection to colouring-matter or other impurity left with the morphia, by availing ourselves of his capital suggestion of titration of the morphia by an acid; see our Table on the effects of alcohol (CHEMICAL NEWS, vol. lvii., p. 94), where the morphia crystals, freed from the rest of the opium alkaloids and from narcotin, lose very nearly 1 per cent in weight by titration. This final

determination of the morphia by titration, which we owe to Mr. Allen, has not been used by any of the chemists whose processes we have investigated.

May we ask why Mr. Allen employs the term "assay of morphia," &c.? Do not let us Englishmen corrupt our own language. Surely "assay" to a chemist involves the idea of furnacing of some sort.

We have now cleared the way for considering our present process for the determination of morphia present in opium. We say designedly, our present process, which still rests on the proper use of the three reagents, morphiated spirit, morphiated water, and benzene, long employed by us, and described by the late Mr. Teschemacher, jun., in the Chemical News (vol. xxxv., p. 47). It must be a singularly perfect process of estimation, to our minds incompatible with vegetable substances, for chemists to have frequently and continuously employed a method for very many years without observing the advantage of improving and simplifying such methods, as we have done with the one in question. The conclusions we have arrived at, and stated in the foregoing pages, have suggested to us the improvements required, and the means whereby our process would be made to yield more trustworthy and more accurate results than were possible ten years since.

We now prefer to employ 200 grains of opium, if the sample permits,—

1. To thoroughly exhaust this with warm distilled water.
2. Then concentrate this watery extract to a thin syrup in a shallow dish, over a water-bath, which we prefer should not boil.
3. Transfer this thin syrup to a suitable flask, which permits the use of a soft cork, using a few drops of water successively, to wash out the dish. Add to the contents of the flask 50 fluid grains of alcohol, sp. gr. about 0·820, and about 600 fluid grains of ether. Mix gently, but thoroughly, and then add some 50 fluid grains of ammonia, sp. gr. 0·935.
4. Shake the contents of the flask well to precipitate the alkaloids in arenaceous crystals, with occasional agitation during the ensuing eighteen hours.
5. Transfer the contents of the flask to a vacuum filter, and permit all the adherent liquid to be drawn away, washing out the flask with our morphiated spirit, and continue its use till the liquid passes colourless. Now wash with morphiated water, till this also passes colourless.
6. Now dry, slowly at first, finishing at 212° F. Transfer the dried substance to a mortar, reduce it to a very fine powder, and digest it thoroughly in benzene, to dissolve the narcotin and such of the opium alkaloids, other than morphia, which may be present.
7. Transfer this mixture to a vacuum filter, wash out the mortar carefully with benzene, which use to wash the powder thoroughly. This, then, will be morphia, free from other opium alkaloids and narcotin, but still containing colouring and possibly other organic matters to the extent of 3 to 10 per cent. Dry and weigh this powder.
8. Now ascertain the percentage of crystallised morphia by titration of this powder with standard hydrochloric acid and litmus as the indicator, by weight. This acid is so made that 1000 grains by weight shall exactly neutralise 100 grains of pure morphia crystallised from water, washed with ether, and gently dried finally at 212° F.

We invite and shall welcome experimental criticisms on the foregoing method, but must be pardoned for neglecting to notice *obiter dictu* guesses, or opinions unsupported by experimental proof.

We do not claim perfection for our method, nor that it is impossible to extract more morphia from opium than we have hitherto done. We have taken many years to improve our method, so that we can procure considerably more morphia from opium samples than we formerly could do, and we quite hope yet to simplify or so improve our method that we may yet raise our results. We think that in any case such augmentation must be slight, seeing that at the start and basis of our plan ensures the complete exhaustion of the opium under examination, and involves no taking of aliquot parts, but that as we begin with a known weight, so we end with the result from this known weight. It is true that certainly at two points of our method loss of morphia may occur, but the traditions and habits connected with a commercial laboratory of more than fifty years' standing, where analysis goes on from day to day, are great safeguards in this respect; whilst if the rumours which reach us are true it is not loss we are accused of, but its opposite. "Teschemacher and Smith are always too high" seems to be the complaint. The manufacturer of salts of morphia whose mode of manufacture yields him less, and always less, morphia than our returns, cries they are always "too high," instead of suspecting that his mode of manufacture demands rectification, and that he always loses morphia, and always must do so, unless he discovers and amends the sources of loss and leakage involved in his mode of working. This is human nature, as is also the belief we have met with at times that our returns of the valuable contents of any produce or drug manipulated by them should allow for the inevitable loss incurred in manufacture, at which we shook our heads as impracticable and outside the scope of our duties. One gentleman, as we have been informed, has distributed duplicate samples of opium among three or four chemists, with instructions to determine the amount of morphia in them, having already the results of our return of the same sample. All these analysts made returns lower, we think considerably lower, than we did; whilst, to confirm irrefragably our blundering, these gentlemen agreed very closely with each other. Could more be wanted? May we urge, in arrest of judgment, that these analysts may have adopted the process of the *British Pharmacopœia*, that of Mr. Stillwell, or some one of the many we have examined, when, in accordance with Squibb's law, the results will be almost exactly comparable among themselves.

It is, however, certain that none of the methods we have described yield so high a return of morphia as our own, and that loss is the characteristic feature met with in all these methods; whilst it is just as certain that our process cannot yield too much morphia,—*i.e.*, "too high" results.

All we pretend to do is to return results certifying to the amount of pure crystallised morphia which can be obtained from a given sample of opium. And, further, that we can and do obtain more morphia than has yet been procured from opium by other analysts.

Commercial Sale Rooms, Mincing Lane, and
1, Aubert Park, Highbury, London, February, 1888.

Notes.

For Morphiated Spirit.—Digest a large excess of morphia in rectified spirits of 80 per cent, for several days, with frequent agitation. Filter for use.

For Morphiated Water.—As above, substituting distilled water for spirit.

In the *Pharmaceutical Journal* (vol. xii., p. 704) we find it stated, on the authority of Dr. Squibb, that "For more than thirty years it has been unlawful for the United States Custom House examiners to allow any opium not containing at least 9 per cent of morphia to pass into the country." Thus the United States Custom House officials are able, at their will and pleasure, to pass or reject every case of opium imported.

In the foregoing pages we have shown that, granting the capacity to examine opium to these officials, involving a huge admission which we could not grant in good faith, yet these officials have no method whereby they could determine whether or no an opium does contain 9 per

cent of morphia; so that they cannot fulfil their instructions, but simply act according to their will and pleasure.

In illustration of the above, some friends of ours recently shipped ten cases of opium to New York, averaging 10·20 per cent morphia. Of these ten cases, six were rejected as containing less than 9 per cent morphia. We hear further that these rejected ones yield from 7·40 to 7·98 per cent: this second place of decimals, instead of 8 per cent, points to an accuracy which will, we fear, be for a long while the distinctive characteristic of the New York Customs' analysts.

If they be correct the happy consignee will secure four chests at 13½ per cent morphia instead of 10·20 per cent, —a gain of 3·30 per cent, solely due to the lawful action of the Customs of the United States.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

(Continued from p. 98).

FURTHER experiments have been made by Ihmori (*Wied. Ann.*, xxxi., 1006, 1887). He finds that the water films on clean unvarnished metal surfaces are extremely thin, varying from 10 to 3 $\mu\mu$. On oxidising metal they may be twice as thick, and he inclines to the view that in all cases the phenomenon is due to oxidation. Varnished metal may in 20 m. absorb enough to produce a layer 286 $\mu\mu$. thick, and sealing-wax also absorbs large quantities. Nineteen experiments on quartz gave a mean thickness of 22 $\mu\mu$. with a maximum of 62 $\mu\mu$. Six observations made when the crystal had been previously washed gave a mean of 4 $\mu\mu$. and a maximum of 6 $\mu\mu$. only. The mean result of 11 experiments on platinum was under 3 $\mu\mu$. the maximum being 12·2 $\mu\mu$. In the case of a piece which was specially cleaned by heating, no condensation could be detected. Agate absorbs large quantities of water. Films, the thickness of which varied between 562 and 1640 $\mu\mu$., are stated to be the result of an hour's exposure to a moist atmosphere. It is, however, well known, though Herr Ihmori does not refer to the fact, that agate consists of alternate layers of quartz and a porous form of silica allied to opal. Professor Judd has kindly furnished me with specimens which have been immersed in coloured solutions. These have been absorbed by the porous layers, and thus coloured bands are formed. In this way a good imitation of an onyx may be produced. There can be no doubt that the surface exposed by the agate to the water-vapour includes that of the interior of a vast number of capillary tubes, and is enormously greater than the mere external surface. The quantity of water absorbed does not, therefore, give any indication of the thickness of the water-film, and no deduction as to the radius of molecular action can be drawn from it.

The net result of these experiments is to render it doubtful whether in the case of substances which are not dissolved or chemically acted on by water, any measurable temporary film is formed at temperatures above the dew point. If such a film is formed in these cases, its thickness is, according to Warburg and Ihmori, in general very much less than the radius of molecular action as determined by Quincke.

Pfeiffer (*Weid.*, viii., 635, 1884), who published some experiments on the absorption of gases by solids at high pressures, arrived at the conclusion that layers of ammonia and CO_2, of the thickness of 450 $\mu\mu$. and 240 $\mu\mu$., are formed on charcoal made from fir-wood. As, however, the result is based on calculations made from box-wood charcoal, in which it is assumed that it condenses SO_2, exactly in the same way as glass does, but little reliance can be placed on it. It is probable that water-films play as important a part in the apparent condensation of SO_2 on the surface of glass as they do in that of CO_2.

Another group of experiments has been made with iron oxide, alumina, and silica, which readily absorb water and CS_2. Thus Müller-Erzbach (*Exner's Rep.*, xxi., 409, 1885) measured the grains of finely-powdered oxide of iron under the microscope, and concluded that a certain area was greater than that of a given weight of the powder. He then deduced from this datum and the weight of CS_2 absorbed by the oxide the thickness of the film. Assuming that the specific gravity of the absorbed CS_2 was increased from 1·27 to 1·60, by causes similar to those which affect the specific gravity of water of crystallisation, he concluded that the film was at least 1000 $\mu\mu$. in thickness. Similar calculations (*Exner's Rep.*, xxi., 553, 1885) gave 1700 $\mu\mu$. for the thickness of a film of CS_2, adherent to alumina. He finally concludes that the radius of molecular action is at least 1500 $\mu\mu$. (*Wied. Ann.*, xxviii., 696, 1886). Kayser (*Wied. Ann.*, xiv., 450, 1881), as the result of experiments on the condensation of gases on glass thread, was of opinion that the quantity condensed depended on the closeness with which the fibres were packed, and that the radius of molecular action was of the same order of magnitude as the diameter of the threads. He fixes its magnitude at from 2000 to 3000 $\mu\mu$. As these observations were made before the importance of getting rid of the water film by heating had been demonstrated, they cannot be accepted as supporting this enormous value.

Passing next to the condensation of vapours to the more permanent gases, I may refer to a calculation made by Callendar,* on the assumption that the differences between the coefficients of expansion of air between 0° and 100° C., given by various air thermometers, depend on the quantity of air condensed, when they are cooled, and thus upon the ratio between the surface and volume of the bulbs, which of course varies with their shapes. He shows that the values for the coefficients of expansion of air at constant volume between 0° and 100° C. obtained by Regnault, Balfour Stewart, and himself, would agree if the weight of air condensed between those temperatures is 10^{-6} grms. per sq. c.m. From this we deduce that the thickness of the film removed by heating from 0° to 100° C. would be 10 $\mu\mu$., if the density be assumed to be the same as that of water. Schumann (*Wied. Ann.*, xxvii., 91, 1886) has also recently pointed out that if the layer of air condensed on glass reaches such considerable dimensions, the length of a mercurial thread in a capillary tube would be appreciably different, according as the film was or was not present. He therefore connected a long bent capillary tube with a bulb, and when the positions of the ends of a thread of mercury had been determined it was transferred to the bulb. The tube was exhausted and heated to 312° C., which could be accomplished without heating the mercury. When the apparatus had become cold the mercury was returned to the capillary tube. Its length was found to be precisely the same as before. The thickness of the air film removed by the heating could not, therefore, according to Schumann, have been greater than 70 $\mu\mu$. His method of course involves the assumption, which seems legitimate, that the mercury would not remove the film from the glass as it moved along the tube.

An argument to the same effect may be drawn from some observations made by Bottomley (CHEMICAL NEWS, li., 85, 1885), and published in 1885. He exhausted a vessel containing glass fibres by means of a mercury pump until the pressure as indicated by a McLeod gauge was 0·3 M.† He then heated the vessel and its contents until some of the glass fibres began to soften, and collected the gas which was given off. It amounted in all to 0·45 c.c., at 15° C., and 760 m.m., and when analysed was found to contain 8·24 per cent CO_2, 24·8 per cent O_2, and 75·2 per cent N_2. The total surface of the fibres was 14·48 square c.m. The gas as it left the vessel was dried, and,

* A Lecture delivered before the Chemical Society, Feb. 2, 1888.

* "On the Practical Measurement of Temperature," *Phil. Trans.* clxxviii. (1887), A, p. 161).

† M = 1-millionth of an atmosphere.

it is not stated that the glass fibres had been previously washed, so that there probably was a water film of the magnitude of which no estimate could be formed. It is therefore probable that the gases were partly dissolved, but at all events the observations lent no support to the idea that the gas film on glass dried only by contact with dry air is very thick If we assume that the mixture when collected was of the same density as air, and that when in contact with the glass it had the same density as water, the thickness of the film of condensed gas was 4 $\mu\mu$., which is somewhat less than the number deduced on the same hypothesis from Callendar's suggestion.

On the whole, looking only at the very contradictory results attained by different researches, and without regard to arguments which I shall presently adduce, I must confess that I do not think we can at present draw any certain conclusion as to the magnitude of the radius of molecular action from observations on the condensation of vapours or gases. To justify this view I cannot perhaps do better than quote from two of the gentlemen who have studied the phenomena most closely.

In 1885 Müller-Erzbach remarks (*Exner's Rep.*, xxi., 1885, 407):—"Ich habe nun . . . . in Mittel gefunden, durch welches ich auf einfache Weise glaube beweisen zu können, dass die in Betracht kommenden Molecularkräfte nicht nur bei unmittelbarer Berührung wirksam sind, sondern selbst noch in einem grösseren Abstand als ihn Hr. Quincke nach seinen Versuchen bestimmt hat."

In 1886 Warburg and Ihmori sum up these results as follows (*Wied. Ann.*, xxvii., 507, 1886):—"Es liegt uns fern, die Richtigkeit der Schlüsse Quincke's auzuzweifeln . . . . Allein in den Messungen, welche uri über das Gewicht der Wasserhaut bei Glas und anderen Körpern angestellt haben, ist uns nichts entgegengetreten, woraus eine Wirking der Molecularkräfte auf messbare Distanzen hin zu erschliessen wäre."

The first important attempt to measure the radius of molecular action was made by Plateau ("Statique des Liquides," 1873, i., 210). Arguing that the surface-tensions would decrease if the thickness of a soap film became less than twice the radius, he made experiments to determine whether the pressure exerted on the enclosed air depended on the thickness. His method was open to criticism. The soap-bubble was made of a mixture of soap, water, and glycerin, and thus its constitution would alter unless it were surrounded by aqueous vapour of a determinate tension. No precautions were taken to secure this condition. The bubble was produced at the end of a tube bent so as to form a manometer. The liquid used to measure the pressure was water, while the rate of thinning of the bubble was accelerated by enclosing it in a covered beaker in which were placed some sticks of caustic potash. Under these circumstances it is impossible to say what the final constitution of the liquid might be. By measuring the specific electrical resistance of various mixtures of glycerin and soap and water, and the resistance of cylindrical soap films formed of the same substances, Prof. Reinold and I have been able to measure the changes in the constitution of films when subjected to variations in the temperature or hygrometric state of the surrounding air. We found it very difficult to secure constant conditions, and that under circumstances far more favourable than those of Plateau's experiments the films lost one of the 57·7 volumes of water originally contained in every 100 of solution in times which varied between four and eight minutes (*Phil. Trans.*, Part II., 1881, 486).

(To be continued.)

The Dissociation of Hydrous Oxalic Acid. — H. Lescœur.—The use of oxalic anhydride in volumetry is not practicable. The author prefers to place crystalline oxalic acid under a bell over sulphuric acid at 53° B. At the common temperature it does not effloresce, but merely loses its supernumerary water.—*Bull. de la Soc. Chim. de Paris*, No. 2, 1887.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, March 1st, 1888.

Mr. WILLIAM CROOKES, F.R.S., President, in the Chair.

MESSRS. Lewis Walter Hawkins and B. Henry Gerrans, Jun., were formally admitted Fellows of the Society.

The list of Office Bearers nominated by the Council to be balloted for on March 28th was read.

Certificates were read for the first time in favour of Messrs. Joseph Cowper, St. Andrew's Place, Penrith; Eugene MacSwiney, 18, Lower Kevin Street, Dublin; Henry John Palmer, 126, York Road, Bedminster, Bristol; John Cecil Watson, The Rhyddings, Oswaldtwistle, near Accrington; Thomas Howell Williams, 58, Lady Margaret Road, St. John's College Park, N.W.

The following papers were read:—

19. "*The Origin of Colour and the Constitution of Colouring Matters.*" By HENRY E. ARMSTRONG.

The majority of compounds, especially those of carbon, are colourless; and in the case of elements whose compounds are invariably coloured, the greatest diversity of colouring is often noticeable among the several compounds of one and the same element—as in that of chromium or manganese, for example: it is therefore clear that colour is in a high degree conditioned by special forms of intra-molecular structure, and consequently that any attempt to determine the "origin of colour" must be based on a knowledge of the structure of coloured matters. For this reason it has become possible only within recent years to discuss the relation between colour and constitution. The author first gives an account of what has already been done in this direction, and refers to Graebe and Liebermann's paper on "The connexion between constitution and colour in the case of organic compounds" (*Ber.*, 1868, 106); and to that of O. N. Witt—"Zur Kenntniss des Baues und der Bildung färbender Kohlenstoffverbindungen" (*Ibid.*, 1876, 522). Graebe and Liebermann laid down the rule as of universal application that, excluding coloured metallic salts of colourless organic acids, all coloured organic compounds which have been put to the test are decolourised by reducing agents (quinones, azobenzene, nitro-compounds, &c.); and from this they inferred that colouring matters either contain elements with incompletely saturated affinities, or certain of the atoms are present in more intimate association than their retention in the molecule necessitates. Notwithstanding the change in our views of the constitution of quinone, Graebe and Liebermann's conclusions appear still to be accepted, although if Fittig's contention that the quinones are diketones be correct, their conclusion that the colour of the quinones is conditioned by the intimate union of the oxygen-atoms obviously does not apply. Witt formulated the conclusion that the tinctorial nature of aromatic compounds is the consequence of the presence together of a colour-giving or *chromophoric* group, such as NO_2, CO, N : N, and of a salt-forming group—either OH or NH_2. This chemist directed his attention almost exclusively to the consideration of the nature of compounds possessed of tinctorial properties as distinct from mere coloured substances or pigments. The origin of colour, however, is presumably traceable to similar causes in both classes of compounds, while the property of acting as a dye may conceivably depend on peculiarities which stand in no relation to those which are causative of colour; this is an important question to determine.

The dominant idea on which the argument in the paper is based is illustrated by the author by comparison of the unsaturated hydrocarbons with the paraffins. In the paraffins, which are singularly inert compounds and all but colourless even in the infra-red and ultra-violet

regions of the spectrum, the carbon atoms are united only by single affinities, and the remaining affinities are engaged by *monad* atoms; the unsaturated hydrocarbons are not only more reactive than the paraffins, but the beginnings of colour are manifest in them if examination be made in the regions above and below the visible spectrum. The latter are conventionally represented by formulæ in which the carbon-atoms appear as united by two or three affinities of each, typified by straight lines or dots; these formulæ apparently serve to indicate that the value of a "double bond," is twice, and that of a "treble bond" thrice that of a "single bond," and there can be little doubt that this has long been tacitly assumed, although such a doctrine may not actually have been taught. But within recent years the idea has found favour that "affinity has direction"; v. Baeyer especially has availed himself of this hypothesis in his discussion of the differences in stability of various types of closed chain hydrocarbons. The author would apply it to polyad atoms generally; and in formulating compounds in which such atoms are united by more than single affinities, would represent the polyad atoms as united by curved lines in order to suggest that the affinities are under strain in consequence of their being free to act only in certain directions. In the paper, the author cites a large number of cases among inorganic compounds which he thinks afford evidence that the production of colour is dependent on special modes of atomic arrangement, and particularly on such modes of arrangement as involve the existence of a condition of strain in the resulting system, due probably to peculiarities in the affinity relationships of the constituent elements of the system which prevent complete mutual neutralisation of the affinities. The occurrence of colour, therefore, is more frequently than not concomitant with a high degree of reactivity, the coloured compound being usually one of 'high potential" or slight stability.

Among carbon compounds there is no instance of a hydrocarbon being coloured, giving the term its conventional meaning; and omitting nitro-compounds, there are very few exceptions to the rule that derivatives of hydrocarbons containing only monad radicles are colourless; the exceptions, moreover, are of a very noteworthy character, being either *central* derivatives of anthracene, *i.e.*, compounds formed by displacement of the hydrogen atoms of the central nucleus of anthracene—which although not coloured is significantly fluorescent; or the monad radicle contains at its origin a radicle such as CO. A number of illustrations are given in illustration of this statement. Attention is then drawn to the quinones and their derivatives, Fittig's ketone formula being throughout adopted for these compounds. The author then discusses the constitution of the better known dye-stuffs, and is thereby led to conclusions which in some cases are different from those hitherto accepted.

Azo-Dyes.—Liebermann's experiments on benzene-azo-betanaphthol are referred to, and also those of Zincke and Bindewald, attention being specially directed to the production by these latter chemists from alphanaphthaquinone and phenylhydrazine of benzene-azo-alphanaphthol identical with that obtained from alphanaphthol and a diazobenzene salt. The author thinks that the general bearing of these results has escaped notice, and proposes to apply them to azo-dyes generally, formulating these as of the following types:—

$$O\supset C_6H_4\supset N\cdot NHR' \qquad HN\supset C_6H_4\supset N\cdot NHR',$$

according as they are derived from phenols or amines. The high tinctorial power of the azo-dyes would appear to meet with a more satisfactory explanation on this hypothesis than is afforded by Witt's theory, and it affords a simple explanation of the fact that no acid radicle other than OH, and only ortho- and para-hydroxy or amido-compounds are available for the preparation of azo-dyes. The cases in which this hypothesis will not apply are discussed in the paper.

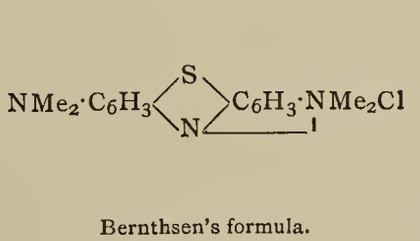
Rosaniline and its Congeners.—Although the formulæ usually assigned to these represent them as compounds of the quinonic type—assuming that in quinone the oxygen atoms although in the para-position are united to each other, the idea that they are quinonic compounds which Graebe, Liebermann, and Caro expressed prior to the publication of E. and O. Fischer's well-known investigation has apparently now been entirely lost sight of. The author would formulate them in the manner indicated by the following examples:—

$$O\supset C_6H_4\supset C(C_6H_4\cdot OH)_2 \qquad HN\supset C_6H_4\supset C(C_6H_4\cdot NH_2)_2$$

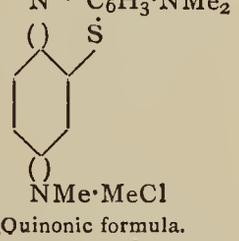
Pararosolic acid. Pararosaniline.

Phthaleïns.—v. Baeyer's researches are commonly held to prove that these compounds are derivatives of phthalide, $C_6H_4\left\{\begin{matrix}CH_2\\CO\end{matrix}\right\}O$. The arguments on which this conclusion is based are discussed in the paper; it is pointed out that the properties of the various compounds classed as phthaleïns are so diverse that it is desirable to more fully examine the evidence on which they are grouped together, especially as, apart from the assumption that the phthaleïns are phthalide-derivatives, there is little reason to believe that the lactides are chromophoric compounds. V. Baeyer supposes that phenolphthaleïn is formed from dihydroxytriphenylhydroxymethanecarboxylic acid by separation of the elements of water from the carboxyl and the methane hydroxyl, a lactonic anhydride being thereby produced; but if the hydroxyl of the carboxylic radicle were to separate with a hydrogen-atom of the neighbouring $C_6H_4\cdot OH$, a derivative of hydroxyphenylanthranol would be obtained. This latter constitution, however, has already been assigned to the phthalideïn isomeric with phenolphthaleïn. The conclusion that interaction does take place in this latter manner in the formation of fluoresceïns would serve to explain the fact that orcinol ($CH_3 : OH : OH = 1 : 3 : 5$) does not yield a fluoresceïn, whereas the isomeric cresorcinol ($CH_3 : OH : OH = 1 : 2 : 4$) does, as an anthracene-derivative could only be formed from an orcinol containing two *contiguous* undisplaced hydrogen-atoms. It is possible that certain of the phthaleïns are derivatives of phenylenediphenyl ketone, $C_6H_4(COC_6H_5)_2$. The formation of triphenylmethane-derivatives from compounds of this type can easily be accounted for, as benzil is converted by alkali into diphenylglycolic acid; and this assumption would serve to explain the formation of additive compounds with acids, such as are obtained from orcinphthalein, for example. It is noteworthy that the dimethanilidophthalein prepared from dimethylaniline is not only itself colourless, but yields colourless salts; this may be a true phthalide-derivative. Also that the diamidodiphenylphthalide which v. Baeyer prepared from diphenylphthalide and which he converted into phenolphthalein, when methylated yields a green compound apparently identical with the "phthalic-green" which O. Fischer prepared from dimethylaniline and which he represented as an anthracene-derivative.

Methylene-Blue.—It is suggested that this also is a quinonic compound, thus:—



Bernthsen's formula.



Quinonic formula.

Other dye-stuffs and coloured compounds are considered in the paper.

Discussion.

Dr. Debus said that Dr. Armstrong had called attention particularly to the type of coloured substances. Now flowers of sulphur at $-50°$ are white; larger pieces of sulphur are nearly colourless; but on warming both forms become more and more yellow, and at $+50°$ are of

an intensely yellow colour. Whatever be the type on which sulphur molecules are built up, there is not the slightest evidence that its chemical properties are changed between $-50°$ and $+50°$, or in other words that the structure of its molecules is altered. The colour of sulphur, therefore, is not dependent on its chemical type between $-50°$ and $+50°$, but on its temperature. Many similar examples can be quoted. Thus zinc oxide is white at common, and yellow at higher temperature. The influence of molar arrangement is seen in the following examples: larger pieces of silver are white, powder of silver is black; pieces of platinum grey, powder of platinum black; a sublimate of mercuric sublimate is dark brown, and powder of the same substance red. In all these cases there is no evidence that the molecular structure of the substances has undergone any change.

Professor Rücker said that if he had understood Professor Armstrong rightly his hypothesis was not in any way opposed to the idea that the forces between atoms acted in straight lines. If for purposes of illustration they made the crude supposition that a carbon-atom had four poles or centres of force on its surface, it was possible to conceive another atom adhering to one of the poles, or to a point on the surface half way between two of them. The heat of combination, the stability of the compound and so forth, would depend on the position assumed by the second atom relatively to the poles, but no single pole would have done the maximum amount of work which the attractions it exerted could perform on the atom until the latter finally adhered to it. In other positions there would therefore be a certain amount of "residual affinity." A position of more or less stable equilibrium might be found in which an atom combining with others was under the influence of a resultant force which was not equal to the sum of its individual components, and he believed that it was ideas of this kind which Professor Armstrong's notation was intended to convey.

As regards the question whether colour was due to the internal arrangement of the molecule, absorption was ordinarily attributed to vibrations set up among the atoms of which each molecule was composed.

He thought that attempts such as that embodied in the paper to connect the physical properties of substances with the molecular constitutions were necessary before any further attempt was made to frame a mechanical theory by which the connection should be explained.

Professor G. C. Foster referred to Professor Armstrong's remark, near the beginning of his paper, that, in the discussion of the colouration of bodies, their behaviour towards the invisible ultra-red and ultra-violet parts of the spectrum could not be separated from their behaviour towards the visible rays. In his opinion this remark was of fundamental importance. It appeared to him that the real question raised by Dr. Armstrong was whether a definite relation could be traced between chemical composition or chemical structure and the existence and position of absorption-bands in the spectrum of the transmitted radiation. The presence or absence of colouration, as it could be judged of directly by the eye, gave no conclusive answer to this question, for, as Professor Dewar had just reminded them, a substance might be as colourless as water, and still exert strong absorption in the ultra-red, or, as in some of the substances examined photographically by Professor Hartley, it might have strongly marked absorption in the ultra-violet. But, more than this, a body might exert selective absorption within the visible spectrum, but if it happened to absorb two complementary colours it would be judged of by the eye as though it were destitute of selective absorption altogether. The subject, therefore, seemed to him to involve a systematic study of absorption-spectra.

Dr. Morley saw great difficulty in applying to inorganic compounds Dr. Armstrong's hypothesis that the less stable bodies were the more highly coloured, and instanced the yellow and red mercuric iodides, the red iodide eing the more stable at ordinary temperatures.

Mr. A. G. Green remarked that, as he understood, Dr. Armstrong considered the colour of organic colouring matters to be due to the unsaturated affinities or high potential of the quinone type to which these compounds can all be referred. Now he believed Dr. Armstrong regarded water as both an unsaturated and a coloured body, so, applying the same argument, why should not all aromatic compounds capable of being referred to the water type be coloured, or, at any rate, such as have sufficient molecular weight?

Dr. Armstrong, in reply, referring to Professor Foster's remarks, said that there was great difficulty in discussing colour, owing to the want of any agreement as to a colour scale, which made it impossible to compare effects produced in different regions of the spectrum; it would undoubtedly be necessary ultimately to take into account the absorption effected in the regions beyond the visible: at present, however, there was far too little information at our disposal for this purpose, but he believed that the same principles would apply in the main. In the course of the discussion he had been asked for explanations of matters which he did not pretend to explain; he did not claim that what he had said was particularly novel, but it did appear to him that it was of importance to group together the facts and the conclusions with regard to the character of coloured compounds in general at which he had arrived appeared to be of significance.

20. "*Researches on Chromorganic Acids. Part II. Certain Chromoxalates of the Red Series.*" By Emil A. Werner.

The author has further studied Croft's red salt, prepared by the interaction in aqueous solution of potassic dichromate and oxalic acid in the proportion of 1 to 7 molecules. Crofts gave to it the formula $K_2Cr_2(C_2O_4)_4 \cdot 12OH_2$, but the author finds only $10OH_2$. Six of the 10 molecules of water are readily expelled, the red salt becoming bluish-grey; but the remainder are removed with difficulty, complete dehydration being effected only at about 300°. The dehydrated compound is of a deep-green colour. It is proposed to represent the red salt by the formula—

$$Cr_2(OH)_2 \begin{cases} (CrO_2 \cdot OK)_2 \\ (CrO_2 \cdot OH)_2 \end{cases}.$$

Several derivatives of the salt are described in the paper.

21. "*Note on Benzyldithiourethane.* By A. E. Dixon, M.D.

Several of the monalkyl substituted dithiourethanes are known. The following is a short account of a new member of the series. It was prepared early in 1887 in Professor A. W. Hofmann's laboratory.

Benzyl mustard-oil was sealed up in a tube with a quantity of ethyl mercaptan slightly in excess of that required by the equation—

$$CS : N \cdot CH_2 \cdot C_5H_5 + C_2H_5SH = CS(SC_2H_5)NH \cdot CH_2 \cdot C_6H_5.$$

The mixture was heated for five hours at a temperature of 120°, the tube opened, and the contents heated for a short time on the water-bath in order to drive off the excess of mercaptan. After standing for a few days the liquid solidified to a crystalline mass. this was dissolved in alcohol, and the alcohol allowed to spontaneously evaporate. By this means large transparent and perfectly colourless prismatic crystals were obtained, over 3 c.m. in length, nearly ½ c.m. broad, the yield being over 80 per cent of the theoretical.

The substance is insoluble in water, moderately soluble in ether, benzene, and ligroïn, and extremely soluble in alcohol and bisulphide of carbon. The alcoholic solution is instantly desulphurised on warming with alkaline lead solution.

The crystals melt at 47° without decomposition; on heating more strongly the substance decomposes into mustard-oil and mercaptan. On analysis the following data were obtained:—

0·2545 grm. burnt with $PbCrO_4$ gave 0·5329 CO_2 and 0·1449 H_2O; or C = 57·10 per cent, H = 6·32 per cent.
0·2308 grm. fused with $Na_2CO_3 + KClO_3$ gave 0·5003 $BaSO_4$, or S = 29·80 per cent.,

which agrees with the formula $C_{10}H_{13}NS_2$.

	Theory.		Experiment.		
C_{10} ..	119·7	56·82	57·10	—	—
H_{13} ..	13·00	6·17	6·32	by diff.	—
N ..	14·01	6·65	—	6·78	—
S_2 ..	63·96	30·36	—	—	29·80

PHYSICAL SOCIETY.

March 10th, 1888.

Professor Reinold, F.R.S., President, in the Chair.

Mr. C. E. Burton was elected a Member of the Society.

Mr. C. L. Addenbrooke exhibited and described a compact form of reflecting galvanometer, lamp, and scale, which he has designed as a portable commercial instrument, and also a modified Post-Office Wheatstone's Bridge. In the galvanometer the coils are easily removed or replaced by others, and loose wires for connecting the coils together are avoided, the required connections being made through the screws which secure the coils in position. The suspension is arranged so that the needle can be quickly taken out without breaking the fibre, and replaced by another for ballistic purposes if necessary. A simple liquid damping arrangement is provided. The lamp (a paraffin one) is enclosed in a copper cylinder, which also supports the scale. The height of the lamp and scale can be varied, and the beam of light can be directed at different altitudes by having the lens-tube mounted on pivots, the line joining them passing through the centre of the flame. The whole is very compact and portable.

Mr. E. C. Rimington read a paper "*On the Measurement of the Power supplied to the Primary Coil of a Transformer.*"

The first part of the paper contains a proof of a formula given by Prof. Ayrton, at a recent meeting of the Society of Telegraph Engineers, for measuring the power given to a transformer by using a Siemens' Watt-meter, and the disadvantages of the method are enumerated. A method is then described in which a high-resistance dynamometer is used. One coil of the dynamometer is placed as a shunt to the primary coil, and the other as a shunt to a known inductionless resistance, R, placed in series with the primary. The time constants of the dynamometer coils are made equal by adding an inductionless resistance to the one having the greatest time constant. Thus arranged, the difference of phase between the currents in the dynamometer coils is the same as that between the P.D. and current in the primary of the transformer. The mean power, p_m, is shown to be—

$$p_m = \frac{K}{R}\,\delta\,(1 + \tan.\,\phi_1), \text{ where } \frac{K}{R}$$

is the constant of the dynamometer for *Watts*, δ the reading of the torsion head, and ϕ_1 the lag angle of the currents in the coils of the dynamometer which can be determined from their time constant and periodic time. The best method of arranging the dynamometer, in order that R may be as small as possible, is discussed.

Prof. Ayrton pointed out that the formula first referred to by the author was given to show *why a Watt-meter should not be used*, and that the method suggested by Mr. Rimington was a modification of the well-known electrometer method, but with an additional serious objection, that the periodic time must be known. He also described a direct-reading method of using an electrometer, on ordinary transformer circuits, suggested to him by Mr. Sayers.

Mr. Blakesley thought the above formula given by Mr. Rimington would only be true where there is no iron in the circuit. He described a method of determining the power by observations on two low-resistance dynamometers, one of which is placed in the primary circuit. Of the other dynamometer, one coil is placed in the primary and the other in the secondary circuit. The power is given by—

$$p_m = A\,\alpha_1\,r_1 + r_2\,\frac{m}{n}\,C\,\alpha_3,$$

where r_1, r_2, m, n, are the resistances, and numbers of convolutions of the primary and secondary coils, A and C the constants of the dynamometers, and α_1, α_3 their readings. A geometrical construction from which the formula is deduced was given.

Mr. Sumpner said all the formulæ at present obtained were founded on the assumption that the induction coefficients of a transformer under working conditions are constant; but in a paper to be brought before the Society shortly, he hoped to show these assumptions to be erroneous.

In replying, Mr. Rimington said if the periodic time was not known beforehand, it could easily be determined from the note given out by a telephone placed near the transformer.

"*On the Magnetic Circuit in Dynamo Machines.*" By Prof. W. E. Ayrton and Prof. J. Perry.

An abstract was read by Prof. Perry. The authors have worked out a number of formulæ for dynamo machines involving the thickness, t, of the armature winding, and α, the highest permanent current density per sq. c.m. of section of that winding. One of these is—

$$W = \frac{2\,v\,N\,t\,\alpha}{10^8}$$

where W = highest permanent output in Watts.

v = circumferential velocity, and N = total induction through the armature. As the winding is thin $t\,\alpha^2 = q^2$, a constant. For the best modern machines, which do not get too hot, q has a value of about 288. It is shown that the best permanent output is a maximum when the magnetic resistance of the space occupied by the armature winding is equal to all the other magnetic resistance in the circuit, and the best machines are found to satisfy this condition. From this important result the characteristic of such a dynamo can be drawn with considerable accuracy. For small inductions the air resistance only need be considered, and a line drawn on squared paper connecting N and S′A′, satisfying—

$$N = \frac{4\,\pi\,S'A'}{10} \div \frac{2\,(d+t)}{a_2},$$

gives the first part of the characteristic, where S′A′ = ampère turns, d = clearance, and a_2 the area of the pole piece exposed to the armature (increased by a fringe of 0·8 $(d+t)$ all round). From the maximum value of N (viz. a_1, β_1), where a_1 = area of diametral section of iron in armature, and β_1 = maximum induction (17,000 to 18,000), find the value of S′A′ from the formula—

$$N = \frac{4\,\pi\,S'A'}{10} \div \frac{4\,t}{a_2}$$

and plot the values of N and S′A′ as the co-ordinates of a point. A curve drawn through this point to touch the line first drawn, at a point corresponding with $N = \frac{1}{2}\,a_1\,\beta_1$ will not differ materially from the characteristic of the constructed machine.

"*A Note on the Employment of an Electro-Dynamometer for Determining the Difference of Phase of two Harmonic Currents of Electricity*," by Mr. T. H. Blakesley, was taken as read.

This is a claim of priority for a method published by

the author in the *Electrician* of October 2nd, 1885, which has recently been described and claimed as the invention of Prof. Ferraris, in a paper communicated to the Royal Academy of Sciences at Turin. In a book on Alternating Currents, published at the end of 1885, Mr. Blakesley shows how the method can be used for determining induction coefficients and capacities.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Will you allow me to state, in reply to certain letters which appeared in the Chemical News (vol. lvii., p. 79), that it was considered advisable by my coadjutors (in nominating certain gentlemen to replace an equal number of those nominated by the Council) to act like the Council itself in not previously asking their consent as to whether they would take office if elected.

In the pink circular issued by the Secretary marked "Important," it states that the (second) circular (bearing my name and giving a list of Fellows for whom those sympathising with our views were requested to vote) was not sent to all the members. This was not the case, the circular having been sent to *all* in the United Kingdom whose names appear in the last published list.

It is, perhaps, needless to say that the second circular bearing my name contains no such discourteous sentence as that given by Mr. Friswell in your last issue, viz., "that the Council is too much composed of mere Professors and Teachers of Chemistry."

From the pink circular above mentioned there seems to be a feeling that candidates nominated by the Council *should* be elected by the Fellows. I understood that the Council nominated certain gentlemen because the outside members, as a rule, did not trouble themselves about voting, but if they did exercise that right no member of the Council could feel aggrieved. Personally, I shall be very sorry if any action which we have taken should have hurt the feelings of any member of the Council, as we desired to show towards them the same good feeling and courtesy which they have always shown towards us.

The names of the gentlemen mentioned in circular "No. 2" were selected mainly because it was understood that they sympathised with the broader views which we advocated. The tendency of professors and lecturers, especially if they belonged to one of the twenty selected schools or colleges, would be not to sympathise with them.

If Mr. Friswell will look at the Council list he will find that 18 out of the 36 members are either professors or ex-professors, 5 are manufacturers, 6 hold Government appointments or are not actively engaged in general practice as consulting and analytical chemists, while 7 only belong to the last-mentioned class, and I think (in opposition to Mr. F.'s views) consulting chemists are as able and as willing to spend time in serving on the Council of the Institute as the lecturers or professors.

I hope Mr. Friswell will stand alone in crediting us with "jealousy."

Mr. Friswell refers to the fact that we might have nominated three candidates from outside, but did not do so. This arangement was not accepted by us because we did not consider that the election of only three more Fellows holding our views would give us the weight required for a fair discussion of the questions at issue.

Other references have been made to our movement as an attempt to gain personal or party ends to the detriment of the highest interests of the Institute, but I fail to see how a regulation passed by a body of the Council composed mainly of Professors or Lecturers to the effect that no one shall enter the Institute in future except through one of twenty schools or colleges in the United Kingdom (to which many of the Professors who assisted in passing this regulation belong) is less of a party or personal movement than one which simply says "that regulation is nonsense and will make the Institute into a clique, leaving out all the chemists educated on the Continent, and all those in the United Kingdom who have not obtained their chemical education in one of the specified schools or colleges.

I see nothing which is of the nature of a party or personal movement in our desire that the doors of the Institute should be thrown open to all comers provided they have attained sufficiently high standards as regards their general education and knowledge of mathematics, physics, and chemistry, and can show that they have worked through a regular course in any college, school, or laboratory of good repute.

It is true that "cramming" may be employed for the purpose of passing the examinations of the Institute, as is the case with all examinations, but the attendence at one of a specified number of colleges does not prevent the student from wasting his time during the sessions and then "cramming" at the end. The fact that upwards of two-fifths of all those who voted at the Annual Meeting were in favour of the changes we suggested in the Council is some guarantee that, if our movement is a party one, the party is a very large one, whose claims must be regarded as worthy of consideration.—I am, &c.,

William Thomson.

Royal Institution Laboratory,
Manchester, March 5, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Surely it is unjust that the Fellows of the old Institute of Chemistry should have been charged an entrance fee of *five guineas* and *two guineas* subscription, while now and until the end of the present month new members are being freely enrolled at an entrance fee of *one guinea* and *one guinea* subscription. The injustice complained of is that members of the old Institute, believing in the official advertisements which appeared in this and other journals, to the effect that the time for the election of members would be limited, believing in this, they supported the Institute by their money and influence, and by these means obtained the Charter, while now that the Institute has become more valuable to its members the door of admission is freely opened at greatly reduced payments. I ask you, sir, is this fair to the members of the old Institute ?—I am, &c.,

Justice.

March 5, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—I feel sure that most bona fide analytical chemists in active practice will extend their sympathy and support to the movement with which Mr. Wm. Thomson has so energetically identified himself with.

Since the foundation of the Institute letters of complaint appear, on reference, in nearly every volume of the Chemical News; and about two years ago the mode of admission into the Institute was freely discussed in these columns. It was then pointed out how absurd it was o the Council to adopt, or even contemplate the adoption, of the "examination before admission" plan.

But in spite of constant remonstrances from all quarters, the Council, in their wisdom, applied the examination system; and it is only too notorious what a conspicuous failure it has proven to be!

It is well known how many there are who enjoy the distinction of "F.I.C." who are not and never have been connected with analytical chemistry in their lives; and

on looking through the list of officers and members one cannot help wondering "how many of these have passed the peculiar examinations of themselves": not one in a hundred! Hence the absurdity of the Council attempting to dictate any examinations with its present lists of members before it.

The strongest advocates for the examinations appear to be those gentlemen connected with universities of recent foundation and "technical schools" (Heaven save the mark!), but who are not apparently graduates of any university!

These are the people who would try to compel men like myself, who have been in the profession over twenty years, to pay a tax and to be examined (!), forsooth, by them! Verily, they are professors!

Had the Institute been started on a sound healthy basis, I should have been only too glad to have supported it in voice and purse if necessary; but when I saw the manner in which "Fellows were made," and the way its business was transacted generally, I held and still hold aloof.

In conclusion, I would suggest to those dissatisfied with the Institute's proceeding; to those professional men who have no belief in examinations as now conducted, but in thorough practical training, and indeed to those of the profession who wish to elevate its "tone" *transparently* —the formation of a new Institute, founded on similar lines to the Institution of Civil Engineers; and it might be called the Institution of Analytical Chemists.—I am, &c.,

A. F. W.

Liverpool.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 8, February 20, 1888.

Preparation and Properties of a Potassium Fluoride, Bihydrofluoride, and Trihydrofluoride.—H. Debray.—Hydrofluoric acid combines readily with the neutral fluorides. Such compounds may contain one, two, or three mols. of hydrofluoric acid to the mol. of potassium fluoride. The two latter can be kept in a liquid state at 65° and at 100°, and they permit in certain cases the reaction of hydrofluoric acid either upon mineral or organic bodies.

New Reaction of the Products of Saponification of Cotton Oil permitting the Detection of One per cent of this Oil in Olive Oil.—Ernest Milliau.—The free fatty acids of cotton oil in an alcoholic solution (5 c.c. to 15 c.c. of alcohol at 90 per cent) are treated in the water-bath with 2 c.c. of a solution containing 30 grms. silver nitrate to 1 litre distilled water. After boiling for a few minutes the fatty acids reduce the silver nitrate and rise to the surface as a paste coloured black by the silver set at liberty. This reaction is not produced with the fatty acids of olive oil. The oil of sesame may be detected by agitating in a test-tube the fatty acids of the oil of sesame, well dried with an equal volume of sugared hydrochloric acid. The acid liquid at once takes a blood-red colour.

The Essence of Spike Lavender.—R. Voiry and G. Bouchardat.—This essential oil is almost entirely free from hydrocarbons, and contains an oxygenated compound identical with eucalyptol.

Bulletin de la Société Chimique de Paris. Vol. xlviii., No. 2, July 20, 1887.

The Hydrochlorates of the Chlorides. Ferric Chloride Hydrochloride.—R. Engel.—Already noticed.

A New Apparatus for the Accurate Determination of Urea in the Liquids of the Organism.—P. Cazeneuve and Hugounenq.—This paper does not admit of reproduction without the accompanying figure.

Two Crystalline Principles extracted from Red Santal Wood: Pterocarpine and Homopterocarpine.—P. Cazeneuve and Hugounenq.—Pterocarpine is a white body, finely crystalline, perfectly insoluble in water, insoluble in cold alcohol, more soluble in boiling alcohol, sparingly soluble in ether, soluble in chloroform, from which it deposits in splendid crystals. It is lævo-rotatory. At 145° it softens and melts at 152°, turning slightly yellow; if submitted to elementary analysis it gives $C_{10}H_8O_3$. It is a neutral body, insoluble both in acids and alkalies. Homopterocarpine has essentially the same properties and is composed of $C_{12}H_{12}O_3$.

Action of Ammonia upon Certain Chloro-derivatives of Ethane: Direct Fixation of the Elements of Ammonia upon Non-saturated Compounds.—R. Engel.—Previously noticed.

Transformation of Maleic Acid and Fumaric Acid into Aspartic Acid by the Direct Fixation of Ammonia.—R. Engel.—Already noticed.

Remark on the Constitution of Inosite.—R. Engel.—In showing that inosite may be regarded as a non-saturated hexavalent alcohol, M. Maquenne confirms the views advanced by the writer ten years ago.

Last Observation by M. Kupferschlæger to the Reply of M. Weill.—The conclusion of a controversy on a volumetric process for the volumetric determination of zinc in zinc powder.

The Substitution of Calcium Phosphate for Gypsum in the Clarification and Preservation of Wines.—M. Hugounenq.—The author shows that "plastered" wines do not improve by age, and that they often contain, in addition to potassium sulphate, salts of magnesium and aluminium. He proposes, as a substitute for gypsum, bibasic calcium phosphate or tribasic phosphates, if free from fluorides and iodides.

Speed of the Reaction of Plumbiferous Zinc with certain Acids in Various States of Concentration and Temperature.—W. Spring and E. van Aubel.—This paper does not admit of useful abstraction.

Certain Derivatives of Propane.—C. Winssinger.—The compounds in question are hydrated orthopropylic alcohol; mercaptan and the orthopropylic sulphides; orthopropyl-sulphonic acid; orthopropyle oxysulphide; the compound of calcium nitrate with propyl oxysulphide; diorthopropyl sulphone; and monopropyl-phosphoric acid and tripropyl-phosphoric acid.

A Novel Carbohydrate, "Quercine," found in Acorns.—MM. C. Vincent and Delachanal.—This compound approaches inosite in its properties, but is distinguished by its crystalline form, its much higher fusion-point, and its less ready solubility.

The Constitution of Clays.—H. Le Chatelier.—Already noticed.

The Molecular Specific Heats of Gaseous Bodies.—H. Le Chatelier.—The author gives his results in the form of a Table.

No. 3, August 5, 1887.

Identity of Dambose and Inosite.—M. Maquenne.—Already noticed.

On Colloidal Copper Sulphide.—W. Spring and G. de Boeck.—The authors suppose that insoluble bodies are polymers capable of existing in a simple soluble state. They prepare copper sulphide, soluble in pure water, by precipitating a solution of a copper salt with hydrogen sulphide and washing the precipitate by decantation in a solution of hydrogen sulphide in water. As the foreign matters are eliminated the copper sulphide becomes

soluble. The authors refer to the researches of Ebell, who has obtained ultramarine.

An Oxide of Manganese Soluble in Water.—W. Spring and G. de Boeck.—The authors obtain this substance by treating potassium permanganate with sodium thiosulphite and washing by decantation.

MISCELLANEOUS.

The Chemical Laboratory of Wiesbaden.—In addition to the director, Geh. Hofrath, Prof. Dr. R. Fresenius, there are engaged as teachers in the establishment Prof. Dr. H. Fresenius, Dr. E. Borgmann, Dr. W. Fresenius, Dr. E. Hintz, Dr. med. F. Hueppe, and Architect J. Brahm. The assistants in the laboratory in the Winter Term 1887—88 were 19 in number and in the Versuchsstation 3. Last term there were 75 students on the books. Of these, 45 were from Germany, 7 from North-America, 6 from Austro-Hungary, 5 from England, 5 from Sweden, 5 from Russia, 1 from France, 1 from Belgium, and 1 from Italy. During the last term, besides the scientific researches, a great number of analyses were undertaken in the different departments of the Laboratory and the Versuchsstation on behalf of manufacture, trade, mining, agriculture, and hygiene.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Bleaching Soft Soap.—A beautiful white soft soap has been in the market for many years. It is, or was, used in the silk trade. Try Price's (or other) soap makers.—G. A. Keyworth.

MEETINGS FOR THE WEEK.

Monday, 19th.—Medical, 8.30.
—— Society of Arts, 8. "Alloys," by Prof. W. Chandler Roberts-Austen, F.R.S.
—— Society of Chemical Industry, 8. "The Polariscope and its Application to Brewing," by John Heron, F.I.C., F.C.S.
Tuesday, 20th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Society of Arts, 8. "What Style of Architecture should we follow?" by William Simpson.
—— Royal Institution, 3. "Before and After Darwin," by George John Romanes, F.R.S.
Wednesday, 21st.—Meteorological, 7.
—— Society of Arts, 8. "The Evils of Canal Irrigation in India and their Prevention," by T. H. Thornton, C.S.I., D.C.L.
Thursday, 22nd.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Telegraphic Engineers, 8.
—— Royal Institution, 3. "Microscopical Work with Recent Lenses on the Least and Simplest Forms of Life," by The Rev. W. H. Dallinger, LL.D., F.R.S.
—— Parkes Museum, 5. "Physical Training of the Greeks and Romans," by A. S. Murray.
Friday, 23rd.—Quekett Club, 8.
—— Royal Institution, 9. "A Lecture with—and without—point," by Sir Frederick Bramwell, D.C.L., F.R.S.
Saturday, 17th.—Royal Institution, 3. "The Modern Drama: English," by William Archer.

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CHEMICAL LABORATORY,
WIESBADEN, GERMANY.
Director—Prof. R. FRESENIUS, Ph.D.

Practical Instruction in the Laboratory .. .. Prof. R. FRESENIUS, Ph.D. / Prof. H. FRESENIUS, Ph.D. / W. FRESENIUS, Ph.D. / E. HINTZ, Ph.D.

LECTURES.

Experimental Chemistry (Inorganic) — Prof. H. FRESENIUS, Ph.D.
Experimental Physics .. .. / Stöchiometry .. .. — W. FRESENIUS, Ph.D.
Organic Chemistry .. .. — E. HINTZ, Ph.D.
Chemical Technology .. .. / Microscopy, with exercises in Microscopic work .. .. — E. BORGMANN, Ph.D.
Chemistry and Analysis of Foods .. — Prof. H. FRESENIUS, Ph.D. / E. BORGMANN, Ph.D. / W. FRESENIUS, Ph.D., and E. HINTZ, Ph.D.
Hygiene .. .. / Practical exercises in Bacteriology .. — Dr. med. F. HUEPPE.
Technical Drawing, with exercises .. — J. BRAHM.

The next Session commences on the 24th of April. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. Kreidel's Verlag, at Wiesbaden, or to the undersigned.
Prof. R. FRESENIUS, Ph.D.

ST. PAUL'S SCHOOL.—An Examination for filling up about Four Vacancies on the Foundation will be held on the 11th of April, 1888, and following days.—For information apply to Mr. S. Bewsher, Bursar, St. Paul's School, West Kensington.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1478.

MAR 88

ACTION OF SULPHUR CHLORIDE ON OILS.

By THOMAS T. P. BRUCE WARREN.

The following details of the *modus operandi* which I generally adopt for examining oils and mixtures of oils and fats may be useful to others interested in this subject.

The sulphur chloride should be mixed with an equal volume of carbon disulphide and kept ready for use. Unless otherwise stated the yellow chloride is referred to; it should be free from *dissolved* sulphur.

Five grms. of the oil or mixture are weighed in a tared porcelain dish, which is well glazed both inside and out; it should have a capacity of about four ounces, so as to avoid loss from spitting. It should not be covered. 2 c.c. carbon disulphide is stirred in and 2 c.c. of the mixture of sulphur chloride added. It is now placed on a hot water-bath and well stirred until the action has fairly commenced; when solidified it is placed in a warm chamber, so as to drive off all volatile products. When two successive weighings are the same it is ready for further operation. The mass will require breaking up so as to allow imprisoned vapours to escape.

The colour and consistency at the end of the reaction and when subsequently dried should be noted; it is now ground up or divided as much as possible. The product may be too tough to break up easily, or, if soft and sticky, a portion of the unaltered oil should be removed first.

It is transferred to a filter tube and well washed with carbon disulphide, so as to remove all traces of unaltered oil, &c., which is received in a tared flask; about 200 c.c. will suffice in any case. It is best to break up the mass after partial exhaustion, especially when the product is hard and tough or soft and adhesive.

Oils, fats, resins, rosin oils, petroleum, &c., not acted on by sulphur chloride so as to yield solid products, may be separated. The melting-point of a fat before and after separation of the oil is an interesting and useful matter. The viscosity of a mixture containing an ingredient acted on by sulphur chloride is of importance in examining lubricating compounds. Let us, however, remember that some resins yield insoluble compounds with sulphur chloride.

It is advisable to perform the experiments in duplicate so as to obtain a check on the result, the difference should not exceed what we allow on an ordinary commercial analysis.

The washing with disulphide is carried on under pressure; a foot blower is convenient, but by closing the top of the filter tube and clasping it with the warm hand will be sufficient. The exhaust will, in some cases, give a further yield of solid product; in these cases, if a larger quantity of chloride be used in the first place, a harder product will be obtained. This is not to be recommended unless for special purposes, because uniformity is aimed at in result, and it is not desirable to alter the oils too much.

The exhaust is weighed after removal of disulphide, and when the weighings are constant, this is deducted from the contents of the dish, by which we obtain the weight of insoluble solid product. This procedure is more simple and reliable than weighing the insoluble solid product. The smell and colour of the exhaust will, in many cases, reveal what the oil itself is, in spite of blending, refining, &c.

The colour and tenacity of the solid product is so very characteristic in most cases that no difficulty will be felt in deciding what the oil or mixture is; thus, arachis oil in lard or olive oil can be instantly detected from cotton-seed oil. Arachis oil is largely adulterated with cotton oil, and I have no doubt that in many cases where cotton oil is supposed to be present as an adulterant, the intention of a manufacturer has been to use arachis oil. I propose to examine this double adulteration shortly.

Sulphur chloride is sometimes decomposed when added to an oil; the deposited sulphur is removed from the exhaust by washing with ether saturated with sulphur. The oily portion is taken up, leaving the sulphur; we then obtain the weight of exhaust minus the sulphur. If much sulphur is present the exhaust has a cloudy white appearance. This indicates, generally, that the chloride is in excess.

I give the experimental data obtained on a mixture of poppy and linseed oils, both of which are similarly but unequally affected by the same quantity of this reagent.

Mixture, composition unknown, supplied for Fine Art painting:—

	Grms.	Grms.	Mean.
Weight solid product	6·49	6·47	6·48
,, exhaust	1·11	1·12	1·12
,, insoluble residuum ..	5·38	5·35	5·36
Poppy oil gives:—			
Weight solid product	6·43	6·48	6·46
,, exhaust	1·98	1·93	1·96
,, insoluble residuum ..	4·45	4·55	4·50
Linseed oil gives:—			
Weight solid product	6·33	6·39	6·36
,, exhaust	0·75	0·81	0·78
,, insoluble residuum ..	5·58	5·58	5·58

First approximation. Linseed oil, 2·74 grms. Poppy oil, 2·25 grms.

Weight solid product	6·44 grms.
,, exhaust	0·92 ,,
,, insoluble residuum ..	5·52 ,,

We obtain by this approximate mixture too much insoluble residuum and too little exhaust, showing that linseed oil was in excess, and that poppy oil was insufficient. The colour and tenacity of the product showed that this was a very near approach to the mixture.

Second approximation. Linseed oil and poppy oil, 2·5 grms. each.

Weight solid product	6·47 grms.
,, exhaust	1·10 ,,
,, insoluble residuum ..	5·37 ,,

I may just point out here what the average results may have led us to anticipate:—

	Insoluble product.	Exhaust.
Poppy oil	4·50 grms.	1·96 grms.
Linseed ,, ...	5·58 ,,	0·78 ,,
Mean	5·04 ,,	1·37 ,,

so that although we may expect the total solid products to be near what we want, the weight of exhaust is at variance with our requirements, and hence the insoluble product. The linseed oil and poppy oil were obtained from the same firm who supplied the mixture.

The only explanation which I am able to offer is, that by mixing an oil which yields a large amount of exhaust with another oil which yields much less, we are modifying the solvent action of the unaltered portion of the former. A mixture of arachis and cotton oil confirms this. It is on this *mutual action* that the separation of cotton oil in margarine is brought about. We diminish the solvent action of the fats present by increasing the quantity of oil which is affected by sulphur chloride.

NOTE ON THE

OCCURRENCE OF EPSOMITE ON WHITE ISLAND, NEW ZEALAND.

By R. W. EMERSON MACIVOR, F.I.C., F.C.S., F.R.G.S., &c.

I HAVE already dealt with some of the more remarkable mineralogical features of the well-known active volcano in the Bay of Plenty, New Zealand (CHEMICAL NEWS, vol. lvi., pp. 251 to 253), and would now supplement my observations with a note on the occurrence of epsomite.

This mineral is met with in many places on the gypsum covered floor of the crater in the form of an efflorescence having the familiar saline bitter taste.

After careful drying between the folds of white blotting-paper it has the composition $MgSO_4.7H_2O$, and contains a distinct trace of ferrous sulphate.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

(Continued from p. 106).

As Plateau's film lasted two days, it is evident a change of composition sufficient to have caused a marked or considerable change in surface-tension due to thinning might have occurred. Plateau observed no change in the pressure when the colours of the bubble proved that its thickness was 11·8 $\mu.\mu.$ and thence concluded that the radius of molecular action is $< 59\ \mu.\mu.$ This inference is not so certain as he appears to have thought it to be. Maxwell (Art. "Capillary Action," *Enc. Brit.*, ed. ix.) has shown that if we neglect the change of density in the surface of the liquid and the thermal phenomena which accompany the thinning of a film, the surface-tension will remain unchanged until the thickness is equal to the radius of molecular action. It is difficult to estimate the extent to which this result might be affected by a theory which took cognisance of the motion of molecules and the change of surface-density. Perhaps, therefore, all that we are entitled to say is that if no change is observed in the tension of a film of given thickness, the radius of molecular action must be less than that thickness, but that if a change is observed it must be greater than half that thickness. Thus the superior limit fixed by Plateau's experiment would be twice as great as has been generally assumed to be.

Quincke (*Pogg. Ann.*, 1869, cxxxvii., 402) attacked the problem in another way. He placed a layer of Martin's silvering solution between a glass cylinder of 120 m.m. radius and a plane sheet of glass. A double wedge of silver, which was thinnest in the centre, was deposited on the surface. Two sheets of glass thus prepared were fastened together with a small interval between them, with their silver sides inwards, and adjusted so that silver layers of equal thickness were as nearly as possible opposite to each other. A glass cell, open at the top and bottom, having thus been formed, the lower part was immersed in distilled water. The cell being vertical the water rose highest in the centre, where it might be considered to be in contact with the glass. On each side, as the silver sheet became thicker the capillary elevation diminished. It was measured at known distances from the centre, and the angle between the solid and the liquid surface calculated. This would become constant when the thickness of the silver layer was such that the attraction of the glass on the water was negligible. The silver was afterwards converted into iodide of silver, and the thickness of the layer at different parts deduced from the colour. Similar experiments were made with other substances. The results may be summed up as follows, if we write ρ for the radius of molecular action in terms of micro-millimetres :—

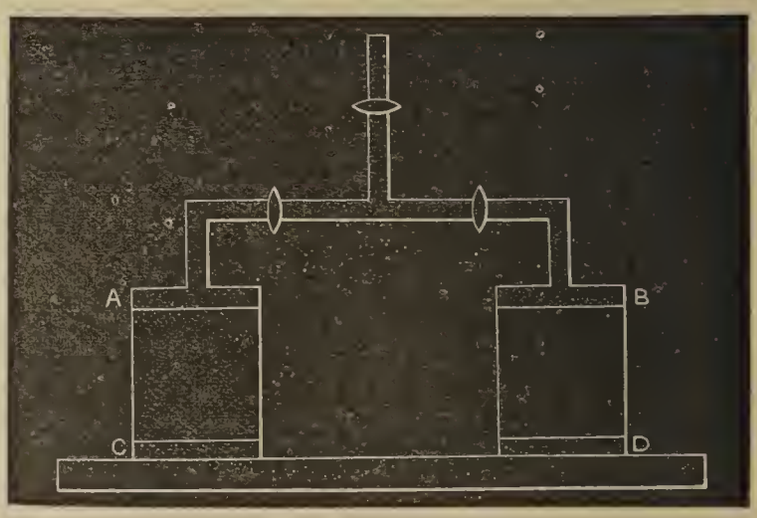
$\rho > 54{\cdot}2$ for water, silver, and glass,
$= 43{\cdot}3$,, mercury, sulphide of silver, and glass,
$= 59{\cdot}0$,, mercury, iodide of silver, and glass,
$< 80{\cdot}0$,, mercury, collodion, and glass.

The quantity of ρ as given by these experiments strictly speaking measures, not the radius of molecular action, but the distance at which the difference between the molecular forces exerted by glass and silver becomes inappreciable. This would probably be somewhat less than the true radius, but, nevertheless, the net result is to show that the radius of molecular action is approximately $= 50\ \mu.\mu.$ It is much to be desired that this conclusion should be in every way tested, and that similar observations should be undertaken by other physicists. I hope to show in the course of this lecture that it does receive important confirmation from the behaviour of thinning soap films.

Plateau's experiment has been repeated and modified in various ways. Lüdtge (*Pogg. Ann.*, cxxxix., 1870, 620), instead of directly measuring the pressure exerted by bubbles, compared the pressures due to thick and thin films by balancing them against each other. A soap film having been formed at the end of a tube, it was allowed to thin, and the other end was then closed by another film. Air was forced in, the films assumed the form of spherical segments, and their curvatures were compared. If p is the pressure exerted by a soap bubble of which T and R are the surface-tension and radius respectively, $p = 4T/R$. Hence if the tensions of the thick and thin films were different, their radii would be different also. He concluded that the radius of molecular action was much larger than Plateau and Quincke's observations would have led us to suppose, and that, contrary to expectation, the thicker film had the less surface-tension. His experiments were repeated and extended by Van der Mensbrugghe (*Bruxelles Acad. Sci. Bull.*, xxx., 1870, 322), who was unable to detect the alleged change of tension. Afterwards, however, he suggested and adduced experiments to prove that the phenomenon was probably real, and due to the cold produced by the continual evolution of fresh liquid surfaces as the films thinned (*Bruxelles Acad. Sci. Mem.*, xliii., 1882, No. 4, 18).

Lastly, Professor Reinold and I (*Phil. Trans.*, clxxvii., Part II., 627, 1886) have employed similar methods.

We balanced two cylindrical films, the one against the other; one of them was kept thick by passing up it an electric current which we have shown carries the matter of a thin film with it (*Phil. Mag.*, xix., 94, 1885). The other was allowed to thin, and the tensions were deduced



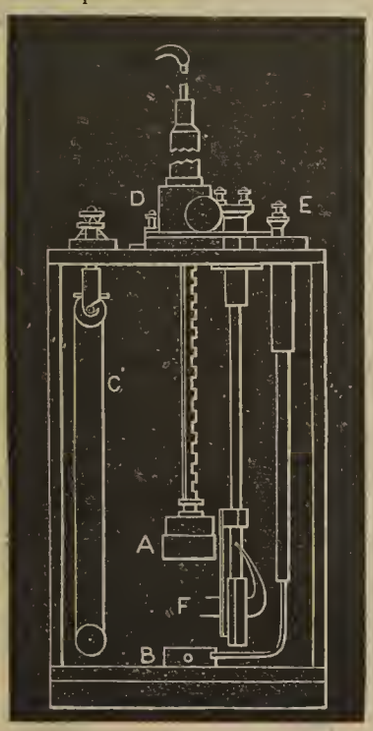
from the curvatures. The above figure represents diagrammatically the essential parts of the apparatus. The cylinders were formed between platinum rings, and their

* A Lecture delivered before the Chemical Society, Feb. 2, 1888

interiors could be put in connection with each other or with the external air by stopcocks. The apparatus actually used was somewhat complicated. The films were formed in a closed glass box surrounded by water. They could be made and adjusted without opening the box, so that the temperature and hygrometric state of the enclosed space were constant. A difference of surface-tension was indicated by a bulging of one film and a contraction of the other. Several possible causes of error were investigated, and as the distorted films were unduloids, formulæ were devised by means of which we could at once calculate the difference of the tensions of the two films when their lengths and maximum or minimum diameters were known. We found, as has indeed been noticed by others, that the surface-tension of a newly-formed film diminishes, and that from 10 to 15 minutes must elapse before it acquires an approximately constant value. By measuring the magnitude of the changes of surface-tension thus developed we proved that they were far too great to be accounted for, as Van der Mensbrugghe supposed, by cooling due to thinning. The calculated change was 0·0016 per cent, while we observed changes of 9 per cent. The effect is probably only a striking instance of the difficulty of preserving a liquid surface pure.

If, however, two films of very different thicknesses, but neither of which had been very recently formed were compared, the difference of tension (if any) was very small, and was not constant either as to sign or amount. We concluded that no evidence of a change in surface-tension dependent on the thickness of the film is furnished by a direct comparison of the tensions of thin and thick films over a range of thickness extending from 1350 millionths of a millimetre down to the stage of extreme tenuity when the film shows the black of the first order of Newton's scale of colours. Had any such difference as large as one-half per cent of the value of the tension existed we must have detected it.

The magnitude of the lower limit when the film appears black was given by the results of a previous research (*Phil. Trans.*, Part II., 1883, 645). We had determined the thickness of black soap films by measurements based on two independent methods, the one electrical, the other optical. In the first we measured the resistance of cylindrical films and deducted the thickness on the assumption that the specific resistance was the same as that of a thick layer of the same liquid.



The apparatus used is shown in the figure. The film was formed between the platinum rings A and B. The ower part of the glass vessel was flooded with the solution, and C is an endless linen band which dipped in the liquid, and could be rotated from the outside. It was thus kept moist, and the hygrometric state of the air was maintained at a constant point. The current flowed from the binding screw D to A, thence through the film to B and E. At F a pair of insulated gold wires penetrated the film. They were connected with the opposite quadrants of an electrometer, and the differences of potential between them and between the extremities of a known resistance inserted in the circuit were measured alternately. From these the resistance of the film between the needles was deduced.

In the second method we passed the two rays of light used in an apparatus* for the production of the phenomenon of interference by means of thick plates through two tubes in which a number of plane films have been formed. A known number of films was then broken in each tube in turn. The thickness was deduced from the displacement of the interference bands on the assumption that the mean refractive index of the thin films was the same as that obtained by the ordinary methods from experiments on the liquid in mass. The results may be summarised as follows:—

Liquid.	Method.	No. of films observed.	Mean thickness in terms of 10^{-6} m.m.	Probable error of a single observation.
Liquide glycérique	Electrical	5	11·9	±0·2
,, ,,	Optical	7	10·7	±0·6
Soap solution, without glycerin	Electrical	13	11·7	±1·4
	Optical	9	12·1	±0·8

The close agreement between these numbers, obtained by different methods, and by calculations based upon differs ent assumptions, proves conclusively that the thickness of a black film is generally about 12 $\mu.\mu$. We found that the thickness of different films might vary within several millionths of a millimetre, but that in any given film the thickness of the black part remains constant—at all events from a short time after its first formation. At first sight, then, it appears as though our result was in direct opposition to that obtained by Quincke, and proved that the radius of molecular action is $< 12\ \mu.\mu$. This is not the interpretation we ourselves put upon it. The black and coloured parts of a film are separated by a sharp line, which shows that there is a discontinuity in the thickness. Thus in extreme cases the rest of the film may be 250 times thicker than the black part with which it is apparently in contact.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, March 15th, 1888.

Mr. WILLIAM CROOKES, F.R.S., President, in the Chair.

MESSRS. Charles Francis Townsend, John Frederick Hayes, and D. A. Nagel were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Ludwig Claïsen, 6, Sopheinstrasse, München; William Henry Dodd, 8, Kempson Road, Fulham, S.W.; John Gill, Gwealhellis, Helston, Cornwall; Frederick Preston de Jong, South Shore, Blackpool; Thomas Enraght Lindsay, B.A., Royal Medical College, Epsom; John George Taylor, 12, Ernest Street, Jarrow-on-Tyne; James Woodward, The Laboratory, Somerset House, W.C.

The following were duly elected Fellows of the Society:—Messrs. Alfred Chiddy, Thomas Ashcroft Elwood, Harold Nicolai Faber, James H. Gardner, James

* Sometimes called a Jamin's interferential refractometer.

Hart, C. Millard King, Vivian Byam Lewes, Charles E. Munro, Frederick G. Ruddock, H. Belcher Thornton, Thomas Edward Towerson, Herbert Trewby, Edward Arthur Wates.

The following papers were read :—

22. "*The Nature of Solutions as elucidated by the Heat evolved on their dilution. Part I. Calcium Chloride.*" By S. U. Pickering.

The data afforded by the experiments of Berthelot and Thomsen being insufficient to determine the nature of the action which takes place on diluting aqueous solutions, the author has undertaken an elaborate examination of the question, selecting calcium chloride and nitrite as the subjects of study.

A new form of mixing calorimeter has been devised, consisting of an oval platinum beaker, divided into two compartments by means of folding doors ; this apparatus secures the identity of the temperatures of the two liquids before mixing, and obviates a dependence on the accurate comparison of two thermometers. The heat capacity of the solutions was determined by means of two equal resistence coils through which the same current flowed and which heated simultaneously a known weight of water and of the solution under examination.

Experiments with the weaker solutions were conducted in the mixing calorimeter ; the stronger solutions were treated like solids, the heat of their dissolution in a large quantity of water being determined. The strongest solutions dealt with were supersaturated, containing only 5·7 H_2O ; the weakest one contained 1400 H_2O, or 0·4 per cent $CaCl_2$.

Various methods of graphic representation were examined, but the only one which led to satisfactory results was the plotting of the heat of dissolution (in an infinite amount of water) of 100 grms. of solutions of various strengths against the percentage composition of these solutions.

The results form a curve of great regularity, but this regularity is only apparent ; on differentiation a series of independent curves are obtained, each of which on further differentiation gives a straight line. (The lines are straight within experimental error, but they all exhibit an inclination towards a curved form, which suggests the possibility of the action being even more complicated than is here shown.) Neither these straight lines nor the first differential curves meet at the points of change when produced. A second differentiation being necessary to reduce the original curve to straight lines, it follows that the action is represented by the equation :—Heat of dissolution $= A + \alpha p + \beta p^2 + \gamma p^3$, p being the percentage composition, and the other letters constants.

Owing to the multiplicity of the breaks and the smallness in the percentage difference corresponding to each additional H_2O, the case is one of extreme difficulty, and the exact position of the breaks is in some instances a matter of uncertainty. To obtain confirmatory evidence the densities of the various solutions were examined ; the curve by which they are expressed split up on differentiation into a series of straight lines, as in the cases examined by Mendeleeff, and the points at which the breaks occur in the curve correspond in every case with those occurring in the heat curve, and, moreover, corresponded as accurately as can be expected with definite molecular proportions of water. The breaks are as follows :—

In heat curve. P.c. $CaCl_2$.	In density curve. P.c. $CaCl_2$.	Mean. P.c.	Composition.	P.c. $CaCl_2$.
50·84	—	50·84	$CaCl_2,6H_2O$	=50·66
45·73	46·62	46·18	$CaCl_2,7H_2O$	=46·81
43·46	43·10	43·28	$CaCl_2,8H_2O$	=43·51
38·52	38·52	38·52	$CaCl_2,10H_2O$	=38·12
32·70	31·8	32·25	$CaCl_2,13H_2O$	=32·15
26 35	25·85	26·10	$CaCl_2,18H_2O$	=25·50
17·52	18·75	18·13	$CaCl_2,28H_2O$	=18·04
6·51	7·40	6·95	$CaCl_2,90H_2O$	= 6·41
0·42	0·49	0·45	$CaCl_2,1400H_2O$	= 0·44

It having been already shown before this Society that the variation in electrical conductivity and the density of sulphuric acid on diluting with water unanimously prove the existence of certain hydrates in solution, as the results of the study of the densities and the thermal changes are shown to be equally unanimous in the case of calcium chloride solutions, the author is of opinion that there can therefore no longer be any reasonable doubt but that solutions do in reality consist of such hydrates, and holds that any theory of the nature of solutions which ignores their existence must be rejected absolutely and for ever.

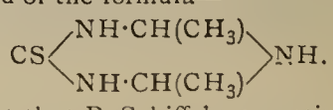
Discussion.

Dr. Armstrong said that although personally he was prepared to agree with Mr. Pickering in his conclusions, he thought that probably very many chemists would hesitate to accept Mendeleeff's explanation until evidence of the existence of definite hydrates in solution had been obtained by discussing the dependence of a greater variety of properties on composition : the fact that the same results were arrived at by discussing heats of dissolution and densities in the case of calcium chloride was therefore a most valuable addition to our knowledge. Mr. Pickering had incidentally raised the question whether the curves actually met at points corresponding to definite hydrates —the observations hitherto made were not sufficiently numerous to determine this, but judging from the results arrived at by Mr. Crompton in discussing electrical conductivity values, they probably did not ; it was necessary, in fact, to prolong the curves in order to determine the points of intersection. The curves begin to change direction at some distance on either side of the points corresponding to particular hydrates : this probably was due to the fact that in a given solution, even before sufficient or more water is present to form a hydrate, A, a varying quantity of a hydrate, B, richer in water, or of a hydrate, C, containing less water, according to circumstances, is formed. If this be the case, it is to be expected that if sufficiently numerous observations are made at different temperatures, it will be possible by Mendeleeff's method to determine not only the nature of the hydrates present, but also within certain limits the extent to which dissociation has set in.

Mr. Crompton pointed out that Professor Pickering's results again showed the necessity, in this and kindred problems, of no longer assuming a curve to be continuous simply on account of its presenting a smooth and regular appearance : on analytical treatment such an apparently continuous curve might break up and prove to be discontinuous and made up of a series of curves, as in the present case. The apparent regularity of Thomsen's heat of dissolution curves was largely owing to the method of representation adopted, and want of a sufficient number of observations in most cases prevented an analysis of his results. The method hitherto pursued of merely measuring the heat evolved at points where breaks in the curve might be expected to occur, was also hardly calculated to lead to the detection of such breaks, as these would best be discovered when the directions of the intermediate curves had been determined.

23. "*The Action of Triocyanates on Aldehyde Ammonias.*" By A. E. Dixon, M.D.

The author describes the products of the interaction of benzylthiocarbimide with aldehyde-ammonia and valeraldehyde-ammonia ; of ethyl-, allyl-, phenyl-, and ortho-tolylthiocarbimide with aldehyde-ammonia ; and of phenylthiocarbimide with valeraldehyde-ammonia. They apparently may all be regarded as derivatives of the compound which Nencki obtained from thiocarbamide and aldehyde-ammonia ; this the author represents as a closed chain compound of the formula—



It is pointed out that R. Schiff, by operating in practically the same way, obtained compounds differing in composi-

tion from those obtained by the author; and it is suggested that Schiff may not have prepared the substances in a sufficiently pure state for analysis.

24. "*Carboxy-derivatives of Quinone.*" By J. U. Nef.

The author originally undertook the preparation of quinonetetra-carboxylic acid, $C_6(O_2)(CO_2H)_4$, in order to compare it with croconic acid, which has the same percentage composition, the constitution of which was undetermined at the time when the experiments were commenced; the results are entirely confirmatory of the conclusion that croconic acid is not a benzene-derivative.

All attempts to oxidise durenequinone, $C_6(O_2)(CH_3)_4$, proving unsuccessful, durylic acid, $C_6H_2(CH_3)_3 \cdot COOH$, was converted into dinitrodurylic acid, from which by oxidation with permanganate the tetracarboxy-acid was prepared; and ultimately this was converted into quinonetetracarboxylic acid. The preparation both of these compounds and of a variety of intermediate products and derivatives and their properties are fully described in the paper: a portion of the results have already been published in the *Annalen* (ccxxxvii., 1; *c.f. Chem. Soc. Abs.*, 1887, 255).

Ethylic diamidotetracarboxylate, from which the quinone carboxylate was obtained by oxidation with nitric acid, closely resembles the allied diamidoterephthalate studied by v. Baeyer; on reduction it is converted into a hexahydrobenzene-derivative — ethylic paradiketohexamethylenetetracarboxylate,—

$$CO\begin{cases} CH(CO_2Et)\cdot CH(CO_2Et) \\ CH(CO_2Et)\cdot CH(CO_2Et) \end{cases} CO.$$

Ethylic quinone tetracarboxylate has a yellow colour, but is odourless; it sublimes readily without decomposing, and is scarcely acted on even by prolonged heating with concentrated nitric acid. Ethylic quinoltetracarboxylate, $C_6(OH)_2(CO_2Et)_4$, prepared by reducing the quinone with zinc-dust and acetic acid, is a very remarkable substance: on further reduction it is converted into the paradiketohexamethylenecarboxylate, which most closely resembles Herrmann's ethylic succinosuccinate; it exists apparently in three distinct modifications, only two of which, however, have been studied: the one modification is green and crystallises in needles; the other is pale yellow and crystallises in plates; after fusion and cooling, the former appears dark yellow, the latter bright yellow. If either modification be separately dissolved in carbon bisulphide, a solution is obtained from which the two substances crystallise out together; the solution has the same colour and the same absorption spectrum whichever modification be dissolved. In the paper the author calls attention to a number of similar cases of dimorphism. Quinoltetracarboxylic acid has a pale yellow colour, and yields yellowish metallic salts which exhibit a characteristic green fluorescence; it is not converted into quinonetetracarboxylic acid by oxidising agents: a similarly remarkable resistance to conversion into the corresponding quinone-derivative has been observed by the author in the case of quinolcarboxylic acid.

25. "*The Action of Acetone on Ammonium Salts of Fatty Acids in presence of Dehydrating Agents.*" By S. Ruhemann and D. J. Carnegie.

As chief product of the interaction of acetone and ammonium acetate in presence of phosphoric anhydride, the authors have obtained a base of the formula $C_9H_{15}N$, which they find is identical with the dehydrotriacetonamine discovered by Heintz. On treating the compound $C_9H_{15}N$ with bleaching-powder solution, it gave an unstable chlorinated derivative: on submitting this to the action of alcoholic potash a liquid (b.p. 78° to 79°) was obtained which the authors regard as a new isopropyl alcohol hydrate of the formula $C_3H_8O \cdot OH_2$. The same substance was produced on substituting formate and butyrate for the acetate: hence it follows that only the ammonia of the salt is concerned in the formation of the base.

26. "*A Method of Estimating Nitrites either alone or in presence of Nitrates and Chlorides.*" By T. Cuthbert Day.

The method consists in saturating the solution containing the nitrite with solid ammonium chloride, boiling the mixture in a suitable apparatus, after removal of the air by carbonic anhydride, and collecting and measuring the nitrogen evolved; interaction takes place according to the equation $NO_2K + NH_4Cl = KCl + 2OH_2 + N_2$, hence the quantity of nitrite present in the substance under analysis is calculated from half the volume of nitrogen obtained.

The Anniversary Meeting will take place on Wednesday, March 28th, at 8 p.m. The President will deliver an Address on "Elements and Meta-Elements."

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Annual General Meeting, March 1st, 1888.

Address of the President, Dr. Odling, M.A., M.B., F.R.S., &c.

In the Anniversary Address which it was my privilege to deliver a twelvemonth ago, I was able to announce to the Fellows and Associates then present, that the bye-laws of the Institute, as made, revised, and confirmed at successive general meetings, held on or between March 26th, 1886, and February 15th, 1887, had, shortly before the occasion of our then anniversary, been rendered effective, by reason of their having received the formal allowance of the Lords of the Privy Council; and that, from that time forth, the conduct of the affairs of the Institute would have to be, as I need scarcely say it has since been, in accordance with the provisions of the bye-laws. These bye-laws, however, are far from being the sole or even the main authority under which the Institute of Chemistry carries on its functions as a Chartered Corporation. Even its authority to make bye-laws at all is limited by the conditions of the Charter; and it was for the Lords of the Council, among other things, to satisfy themselves that these conditions were strictly fulfilled. Accordingly, for a declaration broadly of the objects, constitution, and duties of the Institute, we have to look to the words of the Charter, wherein is accorded, among other powers, the power to make bye-laws, primarily for all or any of certain specific purposes set forth in the Charter; and then, more generally, such bye-laws as from time to time seem "requisite for the management and regulation of the affairs and property of the Institute, and the better execution of this our Charter, and the furtherance of the objects of the Institute." This last expression, "the furtherance of the objects of the Institute," has reference of course to its declared objects, as stated in the petition serving afterwards as the preamble of the Charter,—these objects being referred to in the Charter itself as "laudable and deserving of encouragement." One of these objects, and, indeed, the one most of all dwelt upon, is declared to be "the elevation of the profession of consulting and analytical chemistry;" and the strongest ground put forward, on behalf of our claim then being made for incorporation, is expressed in these words, that "besides other advantages such incorporation by Charter would be a public recognition of the profession of analytical and consulting chemistry, and would tend gradually to raise its character, and thus to secure for the community the existence of a class of persons well qualified to be employed in the responsible and difficult duties often devolving on them." Believing in the sincerity of the representations so made, namely, that our main object was the elevation of the profession, and that our incorporation as a chartered body would tend to effect that object, the coveted Charter, with power

to make bye-laws, was after some consideration accorded us; and, by the allowance finally granted to our code of bye-laws, we were enabled to make our proper start, without further let or hindrance, a twelvemonth ago, so that we are now, as we were not until then, fairly on our way.

Being, however, thus fairly started on our way, it only remains for the members of the Institute to fulfil the obligation they have taken on themselves to make the elevation of the chemical profession an object of real solicitude, and to render their at length completed organisation serviceable towards the achievement of this end. Now that the Institute of Chemistry takes its place among the recognised professional associations of the kingdom, it is for the members to determine whether it shall take a prominent place,—whether or not it shall take that place to which its character as the embodiment of one of the most scientific of all professions entitles it. Every professional association has the special conditions of its own craft to take into consideration, its own special advantages to make good use of, and its own special difficulties to contend with. But all professional associations, old and new alike, would seem to have this in common, that they owe their ultimate success and influence, in large measure, to those who, taking a high view of their profession, believed in and worked for its future, and discarding ignoble motives, were determined, that come what might, that future should be a progressive and a distinguished one. Admitting, as we must, that human action is ever the result of mixed motives, from which the great motive of self-interest cannot, as it ought not, to be excluded, there is yet all the difference in the world between an intelligent and widely sympathetic self-interest on the one hand, and a low and confined self-interest on the other; between the self-interest which is consistent with the desire and ambition to achieve a common good, and the narrow self-interest which looks only to a present and purely personal gain. That the Institute of Chemistry, developed in a liberal and enlightened spirit, may and will become the means of conferring real benefits upon those engaged in the practice of professional chemistry—that it will at any rate achieve for its members no less of good than other well-regarded professional associations have achieved for theirs—does not, I think, admit of question; and on this point I propose to say a few additional words further on. But it was never intended to effect advantages of a purely personal kind; and in justifying the claim which we made to be intrusted with a Charter, the idea that we had any such personal advantages in view was only mentioned to be at once repudiated. By our acceptance of the Charter, granted as it was in the terms of our own application, we are pledged to make the Institute subservient to public and not to private ends. But alike on public and private grounds, we desire to make it a respected and influential organisation, not unworthy of the eminently scientific profession which it claims to represent. Great and powerful institutions, however, are not to be looked for as the outcome of paltry aims, but rather of earnest single-minded effort on the part of those animated by the sense of a high and worthy purpose to be achieved.

The Institute of Chemistry differs from, at any rate, the greater number of professional societies in this, that its organisation was from the first, as it still is, essentially democratic. The majority of these societies have been, not a few of them still are, more or less oligarchic. They were founded and fostered, for the most part, by men of mark in their several professions, fully conscious of their own powers and attainments, earnest and high-minded beyond all question, but a little perhaps out of sympathy with the rank and file of their brethren. In most of the older societies, and in several not so old, the rank and file have had to fight their way, not so much for corporate equality as even for recognition. In the foundation and conduct of the Institute of Chemistry, this condition of things has not obtained, or rather has been almost reversed. Not indeed without the hearty co-operation of several of the more prominent of our body, the original association founded in 1877, of which the present Institute is the outcome and development, was originated mainly by the then younger and less prominent men among us. And the idea from the first, was the comprehension of all engaged in the different departments of chemical work on a footing of corporate equality. It was in accordance with this idea of the union of the entire existing profession, that so soon as we were able to act under our bye-laws, a general announcement was made of our desire to associate with ourselves, to whom the charter was primarily granted, all qualified professional chemists in practice throughout the country, who reciprocally had a desire to associate themselves with us. It is not to be denied that the step thus taken, though supported by a weighty preponderance of favourable opinion, has been objected to by several individual Fellows. It was felt, however, that the Charter of Incorporation was intended for the benefit of the entire profession, and that its use in any spirit of exclusiveness, by those to whom it was primarily granted, would be not only unwise, but altogether unjustifiable. Anyhow, the step has been taken; and with the result that our corporation has been increased by an addition of about two hundred new members, whom I beg to assure we are heartily glad to welcome among us. Thus reinforced by combination, it remains for us all, old and new members alike, to bear in mind the avowed paramount object of the Institute, namely, "the elevation of the profession of consulting and analytical chemistry." It is for us to show that the members of a profession organised like our own, in which the entire body is self-governing, are not less mindful of the real and permanent interests of our profession than are the oligarchic few who, in so many instances, constitute the governing bodies of other professional societies. Surely, in our case, it is for the self-governing many to show a like spirit of earnestness and high purpose to that manifested in other cases by the exclusive few; who, stimulated by the sense of their position and responsibility, have devoted themselves with so much persistency and zeal to raise their respective societies to the height of influence and reputation which several of them at present enjoy.

As in other societies, the executive Council of the Institute of Chemistry is subject to an annual excision and filling up of its numbers. Every year one-third of the Vice-Presidents, and one-third of the ordinary Members of the Council become ineligible for re-election. The formal nomination of the new Vice-Presidents, and of the greater part of the new ordinary Members of Council, rests, as in all other societies, with the pre-existing Council; and I venture to think advantageously so. In filling up their list of nominations, the Council, purposely met to deliberate on the matter, have to take into account, and do take into account, a number of more or less conflicting considerations,—the object desirable to attain being clearly the selection of a Council as thoroughly representative and useful as possible. Thus it is obviously desirable that the Council should include representatives of the several divisions of the United Kingdom; or, in other words, that Scotland and Ireland should not be forgotten; as neither should, apart from the question of nationality, the great provincial centres of chemical industry, as Glasgow, Newcastle, Manchester, Liverpool, Birmingham, and Bristol. It is clearly desirable also to include prominent representatives of the different scientific or professional societies, with whom we are most closely in association, as the parent Chemical Society, the Society of Chemical Industry, the Society of Public Analysts, and the Pharmaceutical Society. Again the multifarious departments and varieties of professional chemistry have to be considered. Professors and teachers of chemistry, to whom we look for our successsion of associates; chemists occupying official positions of all kinds; chemists to works and mercantile associations of different kinds; chemists engaged chiefly in the analysis of various

commercial and manufacturing products; chemists engaged chiefly in consulting practice; chemists who have not, and chemists who have previously served on the Council; and above all, those who, interesting themselves warmly in the success of the Institute, possess the knowledge and experience of affairs which makes their co-operation in the work of the Council pre-eminently advantageous. These and such-like considerations are discussed and acted upon at the meeting of Council, at which, after due notice, the selections for nomination are made by ballot,—I would have said at the usually full meeting of Council, but for the circumstance that all our meetings of Council are usually full meetings.

From the number and variety of not always obvious considerations involved, it is likely enough to happen that the selection made by the Council, though susceptible of easy justification, may not always justify itself on mere inspection. Having regard, however, to the different interests that have to be taken into account, it would seem, I think, to most, that the nomination of new Members of Council is better thus left in the hands of some two dozen or more responsible persons, necessarily representative of various departments of chemical work, rather than to the hap-hazard nomination of scattered individuals, or to the joint nomination, with a view to some sectional object, of some particular group of members. On the other hand, any body of men who constitute an executive Council, with the power of nominating to the statutable vacancies created in their body, are admittedly liable, however unconsciously, to act in a greater or less degree under a feeling of clannishness; and are yet more liable to suffer under the imputation of so acting. To counteract this tendency, so far as it may exist, and still more to maintain a common interest and feeling of mutual confidence between the Council and the general body of the Fellows, a special provision has been made in the Bye-laws of the Institute, which is not, I think, to be found in the Bye-laws of any other corporation. By this provision, while the formal nomination of two-thirds of the new ordinary Members of Council is left in the hands of the pre-existing Council, the formal nomination of the other third is left in the hands of the general body of the Fellows. And by exercising this right year after year, as it is advisable it should be exercised, the outside body of Fellows become the nominators of one-third of the ordinary Members of Council or of one-fourth of the entire Council,—this one-third or one-fourth having further its proportionate voice in the selection by ballot of the members primarily nominated by the Council. Considering the variety of interests that have to be taken heed of by the Council in making their primary nominations, necessarily of persons not at all likely to think or act in unison with one another, it is evident that the power of the outside body of Fellows to nominate one-third or one-fourth of the Council gives them a very influential, if not indeed a preponderating, voice in its deliberations. As a matter of experience, there has not been found any party division, or general difference of view, between Members of Council nominated by the general body of Fellows on the one hand, and those nominated by the pre-existing Council on the other. But supposing such a division on party lines to exist, and the nominees of the general body to have been out-voted or treated with scant consideration, in respect to some question regarded as of importance which they had formally brought under the notice of the Council, they might under such circumstances justifiably, and I think only under such circumstances, hitherto quite hypothetical, make their appeal to the general body; and a little consideration will suggest how such an appeal should and how it should not be made. It cannot be too fully recognised that the entire body of members of the Institute constitute the governing body of the Institute, and that the Council form only the administrative executive. It is of course open to each individual Fellow, and still more to any set of Fellows, to bring under the formal consideration of the Council any view or proposal in which they are interested; nor are they bound to acquiesce in its rejection by the Council, should it so fall out. On any matter deemed of sufficient importance, whether or not previously brought under the consideration of the Council, it is in the power of any twenty members of the Institute to have a general meeting called to consider such matter, and, after all sides have been fully heard, to express thereon a decision which it is imperative on the Council to give effect to. It is for the general body of Fellows to consider whether this method of proceeding, specially provided for in the Bye-laws. is not more straightforward and befitting than any kind of attempt by means of *ex parte* representations, to pack a Council with the advocates of some particular view or sectional interest. It is, of course, for the general body to select whomsoever they please as the Officers and Council of the Institute, and circumstances are conceivable in which they might be warranted in a more or less wholesale rejection of the Council list; but having regard to the mode of constitution of the Council, the duties imposed on them, and the support to which they are entitled in fulfilling these duties, such a proceeding would seem to be justifiable only as a last resource, and on some specific grounds of unwise or wrongful action, held to be such by an undoubted preponderance of opinion among the Fellows as a whole. I have enlarged on this topic more fully than I otherwise should from the strong feeling I am under as to the paramount necessity of maintaining a sense of common interest and purpose between the Council and the Fellows at large. With all the failings naturally incident to a system of virtual co-optation, it is yet clear that the duty of making nominations to the Council is a charge for which some set of persons possessing the confidence of the Fellows in general must be responsible; while by means of the special provision, requiring the acceptance by the Council of outside nominations to the extent of one-third the number to be made, any section of the Fellows deeming themselves insufficiently represented have it in their own power to supply the deficiency.

(To be continued.)

NOTICES OF BOOKS.

Modern Theories of Chemistry. By Dr. LOTHAR MEYER, Professor of Chemistry in the University of Tübingen. Translated from the Fifth German Edition, by P. PHILLIPS BEDSON, D.Sc., B.Sc., F.C.S., and W. CARLETON WILLIAMS, B.Sc., F.C.S. London: Longmans, Green, and Co.

FOR a long time no general exposition and appreciation of chemical theories has been open to the English reader. "Daubeny on the Atomic Theory," which was of value forty years ago, is now hopelessly out of date. We are, therefore, no little indebted to Drs. Bedson and Williams for their version of Prof. Lothar Meyer's great work. Great we call it, not in reference to its extent, but to its value as presenting a clear, a judicions, and a fair survey of the entire field.

The work, if we leave out of view the elaborate introduction, which is in itself well worth reading, is divided into three parts—"The Atoms," the "Statics of the Atoms," and the "Dynamics of the Atoms."

In the first of these great sections the author shows the necessity for the atomic hypothesis, explains the difference between atoms and molecules, and discusses the methods by which the relative weights of the former may be determined. Their actual or absolute weights have not, he admits, been determined with a sufficient degree of accuracy. Here, too, at the very outset, he admits the essentially close relation existing between the properties of an element and its atomic weight.

In successive chapters he discusses the aids employed

in the determination of atomic weights, such as the specific gravity of gases, under which head is included a consideration of the relation between the atomic and the molecular weights of the elements, and the specific heat in the solid state. He then comes to the "chemical atoms" themselves. We find him admitting, as probable, that "as the masses which perceptibly occupy space are composed of molecules, and molecules or particles of the first order are composed of atoms or particles of the second order, so atoms are composed of particles of a third or simpler order."

He further admits the improbability of the existence of some sixty or more entirely different forms of primordial matter. But into the grand question of the origin of the elements he does not seem disposed to enter. Nor does he weigh the evidence for or against their primordiality as commonly received. In the meantime he is naturally led to review the hypothesis of Prout. Here, whilst showing that the investigations of Marignac and Stas give results not in exact accordance with the demands of this theory, he refers to the remarkable fact, emphasized by Marignac, that a large majority of the atomic weights are almost exact multiples of the atomic weight of hydrogen. This, Prof. Meyer thinks, can hardly be purely accidental. He suggests, therefore, that the atoms of many at least of the elements consist chiefly of smaller particles of one distinct primordial form,—perhaps hydrogen,—and that the weights of the atoms do not bear a simple relation to one another because they contain, in addition to particles of this primordial matter, varying quantities of the matter which fills space, and known as the luminiferous ether, which is perhaps not quite devoid of weight.

Hence we are naturally led to an examination of the relations subsisting between the atomic weights of the respective elements, and ultimately to the periodic theory. This subject is here worked out at great length, and with constant reference to original authorities. There is one point only to which we regret having to call attention:—We are unable to find any mention of Mr. J. A. R. Newlands as the original propounder of the periodic classification. His name, indeed, occurs once only, and that in the following connection:—"Since Leopold Gmelin, in 1826, called attention in his treatise to relations of this description, the subject has been frequently discussed by different chemists, more particularly by Max Pettenkofer, J. J. Dumas, P. Kremers, J. H. Gladstone, J. P. Cooke, Low, W. Odling, E. Lenssen, J. Mercer, M. C. Lea, J. A. R. Newlands, Carnelley, Crookes, and others." No one, surely, reading this passage, and having no more precise information on the subject, would in the least imagine the position of Newlands! Nor have the translators, who must be fully aware of the facts, rectified this error in a footnote.

Some of Prof. Meyer's remarks in connection with the periodic law, and in general with the quest for numerical relations, are of great value. Thus he writes:—"Numerical relations were sought for where they did not exist, and, what was much more dangerous, the values obtained by experiment were frequently altered in order that they might exhibit relations not warranted by direct observation."

He considers that "in all these speculations we must not lose sight of the fact that the general law upon which the relations between the properties of an element and its atomic weight depend is still unknown." He pronounces it beyond doubt "that the system of the elements based upon the values of their atomic weights will form the basis of future doctrines of comparative affinity."

The prize of discovery here, the author tells us, is "a systematic inorganic chemistry which will not fear comparison with the thoroughly developed system of organic chemistry." But is this all? There are inquirers who are hoping and working for something further!

The two subsequent parts of the work, into which space does not allow us to enter, deal with the statics and the dynamics of the atoms.

We must pronounce this work to be the nearest existing approach to a philosophy of chemistry,—perhaps the nearest possible in the present state of our knowledge.

CORRESPONDENCE.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Mr. Thomson's letter (Chemical News, vol. lvii., p. 110) has one statement in it which deserves notice, and that is:—"Upwards of two-fifths of those who voted at the Annual Meeting were in favour of the changes we suggested in the Council."

The numbers read out were—For the Council list, 158; against, 102 or 105, I am uncertain which.

Now to my knowledge many of those present voted against the Council list simply by striking out Mr. Thomson's name as a protest against his action. All these are included in the minority. I was told in the room, by a gentleman who had means of knowing, that the number of men who voted for Mr. Thomson's list was less than 30, which is (say) 11 per cent of those present either personally or by proxy, and less than 5 per cent of the total number of members.

Mr. Thomson seems to think it strange that his circular was looked on as unfriendly by the Council, and he deprecates any desire to hurt their feelings. The Council may accept this expression in all sincerity; but had Mr. Thomson's scheme proved successful they might well have said, with Bickerstaff, in "'Tis Well it's No Worse,"—

> "Perhaps it was right to dissemble your love,
> But why did you kick me downstairs?"

For the rest I commend paragraph *six* of Mr. Thomson's letter to the careful consideration of all Fellows of the Institute. Not only being a "professor," but having been one is a disqualification; after seeing which one is not surprised to find "5 manufacturers" and 6 holders of "Government appointments" on Mr. Thomson's *Index Expurgatorius*.

This, read with the letter of A. F. W., in the same issue, shows which way the wind blows. Those who wish to see the representative body of professional chemistry something more than an analytical chemists' trade union have had fair warning.—I am, &c.,

R. J. Friswell.

115, Darenth Road, Stamford Hill,
March 18, 1888.

INSTITUTE OF CHEMISTRY.

To the Editor of the Chemical News.

Sir,—Mr. W. Thomson, in his letter in the Chemical News (vol. lvii., p. 110), says "The fact that upwards of two-fifths of all those who voted at the Annual Meeting *were in favour of the changes we suggested in the Council*" (the italics are mine) "is some guarantee that, if our movement is a party one, the party is a very large one."

Now it is a fact "that upwards of two-fifths of all those who voted at the Annual Meeting" did not vote in favour of the list issued by the Council, but it does not by any means follow that these two-fifths were in favour of the changes advocated by Mr. Thomson. It does not seem to have occurred to Mr. Thomson that many—possibly a considerable proportion of that two-fifths—altered the Council list by striking out Mr. W. Thomson's name, and substituting that of some other member whom they considered more likely to maintain the dignity of the Institute. The proxies might be a safer guide, and I was told that those held by the President and Secretary were more than four times as numerous as those in favour of Mr. Thomson and his friends.—I am, &c.,

One who was There.

March 19, 1888

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 9, February 27, 1888.

Artificial Production of Rhombohedric Crystals of Rubies.—E. Fremy and A. Verneuil.—The authors submitted to the Academy rhombohedric crystals obtained by the method which they described in the session of March 14, 1887. This method consists in causing barium fluoride to react at a red heat upon alumina containing traces of potassium bichromate. The regularity of the crystallisation is due to the management of the fire. The crystals are found imbedded in a porous and friable gangue, and may be separated by throwing the entire mass into a bottle of water and agitating briskly, when the rubies, on account of their higher specific gravity, subside to the bottom and rarely require to be purified by treatment with acids. No trace of barium is present. They easily scratch the topaz; like genuine rubies, they blacken if heated and resume their rose-red on cooling.

Crystalline Form of M. Fremy's Rubies.—M. Des Cloizeaux.—Each operation seems to give rise to predominating forms which vary from one preparation to another. The forms examined and measured cannot be clearly described without the accompanying diagrams.

Certain General Conditions of the Fixation of Nitrogen by Vegetable Mould.—M. Berthelot.—The fixation of nitrogen seems to be effected in the form of complex organic compounds. The conditions of fixation are a high degree of porosity; a proportion of water not exceeding 12 to 15 per cent, and not falling below 2 or 3 per cent; the presence of oxygen, since the active microbia are ærobic, and a temperature like that of summer, but not exceeding 40° to 45°. In winter the process is arrested. The fixation, at least in soils without vegetation, has a limit, so that the proportion cannot exceed 1·68 grms. per kilo. of dry soil.

A Process for Determining Chloroform, and on the Solubility of this Body in Water.—G. Chancel and F. Parmentier.—The authors claim precedence as regards the method given by M. L. de Saint-Martin (*Comptes Rendus*, vol. cvi., p. 493).

On the Laws of Chemical Equilibrium.—H. Le Chatelier.—A mathematical paper which does not admit of useful abstraction. The author combats the views of M. Duhem (*Comptes Rendus*, Feb. 13, 1888).

Novel Hydrate of Molybdic Acid.—A. Vivier.—The ordinary yellow hydrate of molybdic acid contains 2 mols. of water. The author has succeeded in transforming this yellow hydrate into a white monohydrate by heating it for some days to 50° to 60° in the nitric solution of ammonium molybdate diluted with an equal volume of water.

The Vapour-density of Aluminium-methyl.—E. Louise and L. Roux.—The vapour-density of this compound, $Al_2(CH_3)_6$, is 5·02. The organic compounds of aluminium, when destroyed by heat, yield metallic aluminium and a mixture of hydrogen and of the ethylenic and formenic hydrocarbides.

Action of Aniline upon Epichlorhydrine.—Ad. Fauconnier.—The author has re-examined the results obtained by Hörmann, and has succeeded in isolating one of the bases mentioned by the latter, which he names dianilglycerin.

Bulletin de la Société Chimique de Paris. Vol. xlviii., Nos. 4 and 5, Sept. 5, 1887.

On Certain Selenites.—M. Boulzoureano.—The author describes five methods for the preparation of these salts, and gives an account of cobalt, nickel, manganese, and cadmium selenites.

On the Bromobenzenes.—A. J. Leroy.—An account of the mono- and di-compounds, and of the action of aluminium chloride upon para-dibromo-benzene.

Ethyl-propyl-acetylene, a New Substituted Ethylenic Carbide; its Hydration.—A. Béhal.—The compound in question, $C_7H_{14}O$, has at 0° the sp. gr. 0·83. Nitric acid colours it an intense blue, which disappears if the temperature is raised.

MISCELLANEOUS.

Is a Safe now a Safe?—At the meeting of the Liverpool section of the Society of Chemical Industry, on Wednesday, March 7th, Mr. Thomas Fletcher, F.C.S., gas engineer, of Warrington, gave a demonstration of the application of some new gas heating appliances, devised by himself for workshop emergencies, one of the feats of the evening being the fusion of a large hole in a plate of ¼ inch thick wrought iron, in a few seconds, without preparation, and with apparatus which could be carried by a man up a ladder and used in any position. The Secretary, in the discussion which followed the experiments, raised the very serious point that with such apparatus as Mr. Fletcher had exhibited and used, a burglar proof safe no longer existed, as it was simply a question of minutes to fuse a hole large enough for a man to enter in any wrought iron or steel door in existence. Chilled iron or steel were powerless to resist the small blow-pipe Mr. Fletcher used, which would penetrate thick iron and steel plates as readily as ordinary carpenter's tools would penetrate wooden doors. The apparatus was devised by Mr. Fletcher for works repairs, and was noisy in action; but, as he explalned, the apparatus could be made silent, and small enough to carry in a hand-bag. This is a very serious matter for bankers and others who have valuable property, and one which will have to be taken up at once by the safe and strong room makers. It is very well-known that tbe professional burglar is ready to utilise the latest applications of science for his own ends; in fact, Mr. Fletcher's furnaces designed to assist in chemical research are well-known as being used by receivers of stolen goods to reduce plate and jewellery to ingots, and these furnaces may be seen in the detectives' museum at Scotland Yard. Bankers have already taken the alarm, and have visited Mr. Fletcher's works with the object of seeing the extraordinary ease with which large openings can be fused in heavy iron or steel plates. It is hardly necessary to say that Mr. Fletcher plainly declares his intention not to devise a silent form of the apparatus, which naturally would be required only for burglar's use, but the light-fingered profession will no doubt take the matter in hand, and most probably succeed in making the apparatus silent, a modification which Mr. Fletcher states can be made. During our own interview with Mr. Fletcher on this very serious matter, he informed us that the present danger is possibly not so great as it appears, owing to the fact that the apparatus necessary to manufacture and prepare the silent arrangement is both costly and large, and as the person who prepares it must have fixed machinery and plant, he will most probably be one of the last to whom the enterprising burglar would apply for his apparatus.—*Warrington Guardian.*

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Incrustation in Boilers.—Can any of your readers tell me if there is any objection to the addition of muriatic acid to a well water which is used for boiler purposes? I find that the incrustation is very much reduced by the above addition. Of course care would be taken not to have any excess of free acid present in the boiler.—W. R.

Colouring Matters of Decaying Wood.—Can auy of your readers give me a few references to any literature on this subject either English or foreign? I am specially interested in the bright green colouring matter to be observed in partly decayed fallen branches of trees in dry forest litter.—A. IRVING, Wellington College, Berks, March 17, 1888.

MEETINGS FOR THE WEEK.

MONDAY, 26th.—Medical, 8.30.
—— Society of Arts, 8. "Alloys," by Prof. W. Chandler Roberts-Austen, F.R.S.
TUESDAY, 27th.—Royal Medical and Chirurgical, 8.30.
—— Institution of Civil Engineers, 8.
—— Society of Arts, 8. "The Panama Canal," by J. Stephen Jeans
WEDNESDAY, 28th.—Geological, 8.
—— Chemical, 8. (Anniversary). President's Address. Election of Office Bearers.

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ST. PAUL'S SCHOOL.—An Examination for filling up about Four Vacancies on the Foundation will be held on the 11th of April, 1888, and following days.—For information apply to Mr. S. Bewsher, Bursar, St. Paul's School, West Kensington.

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TO CHEMISTS.

The Directors of the Sheffield United Gas Light Company require a Chemist. One who has a knowledge of Gas Works preferred. He will be required to make analyses of gas residuals and various products therefrom, and of all materials used in the manufacture of gas or in connection therewith. The whole of his time must be devoted to the service of the Company.

Applications (marked "Chemist"). stating qualifications, age, salary required, previous engagements, &c., to be sent in not later than April 5th, addressed to Sir FREDERICK T. MAPPIN, Bart., M.P., the Chairman of the Company.

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Chemist, who has studied in Germany, and who has had considerable experience in Works and Laboratories, is desirous of entering a Business, with management or part management of same, and with a view to future partnership.—Address, A. C., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

Wanted, an Assistant with some knowledge of the Analysis of Limestones, Clays, &c. State age, experience, and salary required; and address, by letter only to L. C., care of Mr. Windle, 1, Great Queen Street, Westminster.

Well-fitted Laboratory, in a good part of London, to be Disposed of.—Address, X. Y. Z., CHEMICAL NEWS Office, Boy Court, Ludgate Hill, London, E.C.

BARCELONA EXHIBITION.

At the Request of the Secretary of State for Foreign Affairs, the Society of Arts have undertaken to receive applications for space from intending English Exhibitors. The Authorities of the Exhibition have agreed to consider applications for space (except for Machinery) until the end of the present month.

Further particulars and Forms of application for space can be obtained on application to the undersigned.

H. TRUEMAN WOOD, Secretary.

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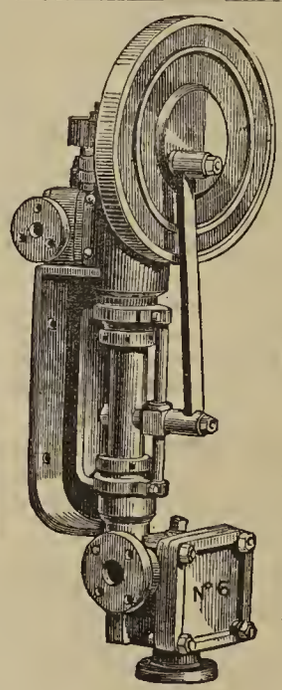

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THE CHEMICAL NEWS.

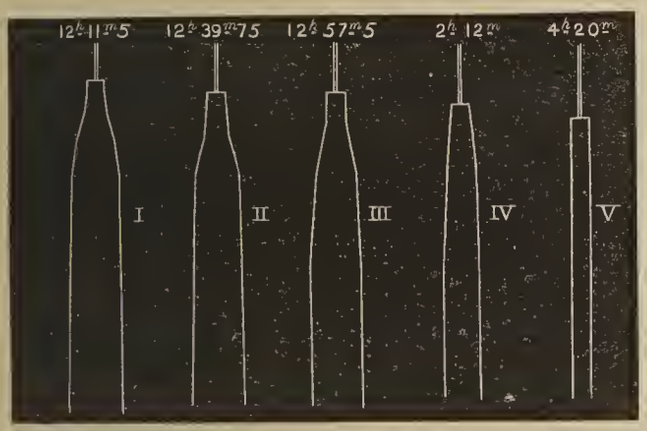
Vol. LVII. No. 1479.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

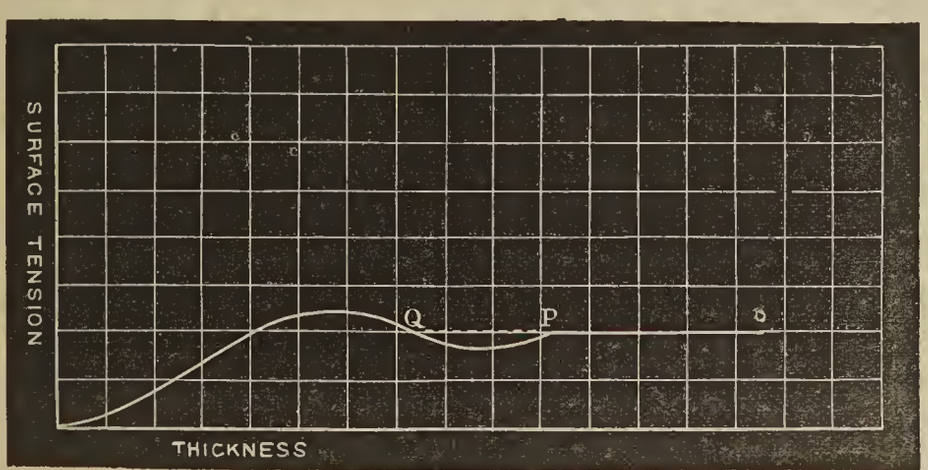
(Continued from p. 115).

The accompanying figures represent the life history of a film which Professor Reinold and I watched for several hours. They are sections deduced from the colours observed at intervals. The thickness is magnified 5000 times more than the length. The upper part of the film was black and the enormously rapid change in thickness at the edge of the black is well shown.



Sir William Thomson (*Proc. Roy. Instit.*, xi., Part III., 485, 1887) and Professor Reinold and myself (*Phil. Trans.*, clxxvii., Part II., 679 and 684. 1886) independently arrived at the conclusion that our observations on the uniform thickness of the black part of a film and on the discontinuity in the thickness at its edge prove that when the film reaches a certain degree of tenuity the surface-tension diminishes to a minimum, and begins to increase again when the thickness is somewhat greater than 12 $\mu.\mu$.

The relation between the surface-tension and thickness may thus be represented by a curve like that shown in the accompanying figure. When the thickness is great the surface-tension is constant. When it reaches the value which corresponds to P, the tension begins to diminish. The thicker parts of the film now tear the thinner parts asunder. Rupture would inevitably follow were it not for the fact that when a certain degree of tenuity is reached the surface tension again increases, and when the thickness is 12 $\mu\,\mu$. becomes equal to that of a thick film, as indicated by the quality of the ordinates at P and Q. Equilibrium is thus possible between two parts of a film of which the one has the thickness corresponding to Q, and the other any thickness greater than that corresponding to P. It is also stable, for any further decrease in the thickness of the film below would cause a further increase of tension. The thinner parts would therefore contract and become thicker. In other words the film could not, under ordinary circumstances, thin to below that thickness for which the surface-tension regains its normal value. The discontinuity at the edge of the black, and the uniform thickness of a black film, are thus both accounted for. Our failure to detect any measurable difference of surface-tension between thick and thin films means not that the radius of molecular action is less than 12 $\mu.\mu.$, but that the changes of tension which produce the sharp edge of the black are certainly $< 0{\cdot}5$ per cent of its whole value.



Let us then examine this remarkable phenomenon a little more closely. It is a result of ordinary observation that in a thinning film there is a range of unstable thickness, which is always missing between the black and coloured parts. The instability is very strikingly shown by an experiment which Professor Reinold and I have often performed. If an electric current be sent up a cylindrical film, the upper part of which is black, the sharp edge is obliterated. The current carries liquid up with it, smoothes off the discontinuity, and the colours pass into the black by a gradual transition through grey.

As soon, however, as the current is broken, the old state of things is re-established. The grey disappears, and the black is again bounded by a definite sharp edge. The change takes place in from ten to sixteen seconds. The colours which thus vanish correspond to the range of unstable thickness. Its lower limit is fixed by the experiments of Professor Reinold and myself as being nearly 12 $\mu\,\mu$. The upper limit is more difficult to determine, as the colour by which the black part of the film is bordered varies, and is probably largely determined by accident.

This, however, may certainly be said, that when the film thins in the normal way the discontinuity in the thickness never occurs within the grey region. The colour next to the black may rise into the second or higher orders; it never sinks below a full white of the first order. It is, therefore, probable that the decrease in surface-tension begins at a thickness less than that which corresponds to the middle of the white, and greater than that which corresponds to the beginning of the black or faint blue which surrounds it. According to Newton these thicknesses are 96 and 45 $\mu\,\mu$ respectively, the mean being 70 $\mu.\mu$. Let us now assume that Quincke's value of the radius of molecular action is correct. The greatest possible thickness at which the surface-tension of a film could begin to diminish is then 100 $\mu.\mu$. Any film thicker than this would have two complete surface layers, and a layer of "interior" liquid separating them. Its surface-tension could not therefore depend on the thickness. On the other hand, if Maxwell's theory were correct, the

tension would remain unaltered until the thickness was equal to the radius of molecular action, *i.e.*, 50 $\mu.\mu.$ It is not, I think, probable that any improvement in the theory would reduce this limit, though it might increase it. Hence we arrive at the conclusion that *the limits of thickness fixed by observation as those between which the surface-tension of a film begins to diminish* (96 *and* 45 $\mu.\mu.$), *are practically identical with the limits deduced by theory from Quincke's experiment* (100 *and* 50 $\mu.\mu.$) *as those within which such decrease ought first to be observed.*

Curious and important as I venture to think this conclusion is, I do not wish to press it too far. The fact that the limits of doubt imposed by two independent lines of argument are at the present moment the same, is a more or less accidental coincidence. The vital point is that the value of the radius of molecular action as determined by Quincke, is certainly of the same order as, and cannot possibly differ much in magnitude from that which may be deduced from the properties of soap films. Quincke's result is, therefore, not an isolated fact. It receives the strongest possible confirmation from a totally different line of research. The matter may also be presented in another way. The radius of molecular action cannot, if Maxwell's theory be accepted, be greater than 96 $\mu.\mu.$, which is the superior limit to the thickness at which the surface-tension begins to decrease. If the ordinary view be correct, it cannot be less than one-half of 45 $\mu.\mu.$, which is the lower limit to that thickness.

Hence the true value of the radius of molecular action lies between 96 and 23 $\mu.\mu.$, and the value found by Quincke (50 $\mu.\mu.$) is intermediate to these.

However, therefore, we combine the figures, we deduce from the two observations the same result, viz., that 50 $\mu.\mu.$ is of the same order of magnitude as the radius of molecular action, a conclusion which it is not too much to say has now strong claims to rank as an ascertained fact.

Van der Waals† deduced from his theory distances between 0·15 and 0·29 $\mu.\mu.$, which are less, but as he thinks not very much less, than the radius of molecular action, and he expresses the opinion that Quincke's value is larger than our knowledge of capillary phenomena will allow. As the numbers he himself obtains are from 0·01 to 0·02 of the thickness of a black soap film, it is evident from the above discussion that they are very much too small.

Passing next to the lower limit of the unstable thickness (12 $\mu.\mu.$), we must enquire what is the cause of the increase of surface-tension to which the uniform thickness of the black film is due. On this point it may be well to speak with a certain amount of reserve until the theory of the constitution of liquids is more fully developed. If, however, we accept equations obtained by Maxwell, in which the movements of the molecules and the surface change of density are neglected, the phenomenon can be at once explained if we suppose that the increase of surface-tension corresponds to a change from attraction to repulsion in the intermolecular forces. If the force exerted by a liquid mass on a particle is repulsive when the distance of the particle from the surface lies between certain limits, then the tension of films, the thickness of which is comprised between the same limits, will increase instead of decreasing as the thickness diminishes. From this point of view, therefore, the explanation of the sharp edge of the black part of a soap film would be that when the molecular force between a liquid bounded by a plane surface and a molecule in its neighbourhood first becomes sensible, it is an attraction, but that at some lesser distance, which is nevertheless greater than 12×10^{-6} m.m., it becomes a repulsion. It must, however, be distinctly understood that the explanation that the increase in surface-tension is due to the action of a repulsive force is only put forward as suggested by Maxwell's theory. I think that this conclusion is very much more doubtful than that which determines the thickness at which the surface tension would begin to diminish, but further discussion of this point would involve a mathematical argument with which I will not at present trouble you.

If, however, apart from the question as to how it may be mechanically explained, the view be accepted that the surface-tension falls to a minimum, and is again increasing when the thickness is 12 $\mu.\mu.$, the very interesting question arises whether there is any experimental evidence that at some thickness less than 12 $\mu.\mu$ it again diminishes.

In answer it may be remarked that in general the black spreads slowly and quietly over the film, and may take an hour or more in travelling from the top to the bottom of a cylindrical film, 26 m.m. long. All the statements I have hitherto made refer to cases in which the mode of formation was thus normal (*Phil. Trans.*, clxxvii. [2], 677, 1886). At times, however, the black is formed into something like a convulsion. Not only does it spread with extraordinary rapidity, but the edge is violently disturbed, and large patches rise through the coloured part of the film. Whenever this occurs the film breaks before long, but in four cases we were able to obtain measurements before rupture. We are not able to produce this phenomenon at will, but the few observations we have been able to make on it are in agreement among themselves. In all cases the cylinder which thinned most rapidly bulged, the other contracted. The differences thus produced between the diameters varied from 0·35 to 0·75 m.m., and could not be accounted for by the sudden renewal of the surface of the thinning film (which would have produced a change in the other direction), or by any cause known to us. The measurement of the thickness of such films would probably settle the question as to whether the black when formed in this abnormal way corresponds to the state of unstable equilibrium which would exist if, after increasing, the surface-tension again diminished as the film became thinner, or to a second state stable within narrow limits of thickness. Such experiments would, however, be attended with extraordinary difficulties, as they would involve measurements on films which are practically always short-lived, and which are possibly theoretically unstable.

(To be continued.)

† "Die Continuität des Gasförmigen und Flüssigen Zustandes." Van der Waals. Translated by F. Roth. Leipzig, 1881 p. 107.

A NEW METHOD FOR THE SEPARATION OF TIN FROM ANTIMONY, AND ESTIMATION OF THE SAME IN SILICEOUS SLAGS AND ALLOYS.

By H. N. WARREN, Research Analyst.

The slags, essentially a silicate of iron, containing besides notable quantities of tungstic oxide, traces of lead, copper, and titanic oxides, are treated by the following method:—After careful grinding of 2 grms. of the slag, the portion is at once introduced into a platinum dish, and treated with an equal mixture of pure hydrofluoric and hydrochloric acids. The whole portion of the slag, after digesting for a few minutes, is entirely decomposed, the greater portion of the SiO_2 being volatilised as SiF_4, the remainder passing into solution and containing besides the whole of the tin as $SnCl_2$, besides other impurities: the solution, after being filtered, is gently heated and saturated with SH_2, the whole of the tin, besides the impurities present, being precipitated as sulphides; the precipitate collected is boiled with NaHO, to separate the bismuth and cupric sulphides present. The solution now contains pure sodio-sulpho-stannate of antimony and tin, which is re-precipitated by the addition of HCl; the antimony and tin sulphides now obtained are decomposed by means of aqua regia, and contain a large excess of HCl, both of

which pass into solution as antimonic and stannic chlorides. The solution evaporated to a small bulk, to deprive it of any large excess of HNO_3 that may be present, is diluted with a moderately weak solution of HCl; to the acid solution obtained an excess of potassium ferrocyanide is added, and the solution—which should now possess a clear blue colour, provided sufficient K_4FeCy_6 has been added—is allowed to boil. The whole of the tin is thus precipitated as stannic ferrocyanide, being insoluble in an acid solution, and, as there is no such compound as antimonic ferrocyanide, the antimony consequently remains in solution (which may afterward be precipitated by SH_2 and estimated in the usual manner). The precipitate containing the tin is now dried and ignited, a few drops of HNO_3 being added, which speedily destroys the organic matter present; the residue is now introduced into a crucible provided with a tubulated lid, and reduced by means of hydrogen or coal-gas, allowed to cool, and dissolved by means of HCl; the tin precipitated as sulphide, oxidised with HNO_3, and determined by the usual method.

The analysis and separation of tin from antimony in alloys may be conducted by precisely the same method, save that the alloy is dissolved by means of aqua regia in place of HCl+HF.

The precipitated antimony sulphide, after the separation of the tin by means K_4FeCy_6, should possess a bright reddish orange colour, entirely free from any brown colouration.

METHODS FOR THE SEPARATION OF IRON, NICKEL, COBALT, MANGANESE, ZINC, AND ALUMINIUM.

By THOMAS MOORE, Erdington.

IN a former article (CHEMICAL NEWS, vol. lv., page 3) a description of a new process for the separation of iron from nickel was given, depending upon the formation of ferro- and nickelo-cyanide of potassium, and of their different reactions with bromine. Since then, however, the process has been modified and altered without affecting the accuracy of the results, so as to avoid the use of phosphoric acid, the presence of which might complicate matters, and at the same time to admit of its application to other separations.

Nickel from Iron.—To the cold concentrated (20 to 30 c.c.), and slightly acid solution, add an excess of solid sodic hydrocarbonate, in such quantity that after stirring a little remains undissolved, and nickel and iron both appear to be thrown down. Now add potassic cyanide until the precipitate dissolves, then heat gently until the pale yellow colour of the ferrocyanide is produced; at this stage the solution should be perfectly clear and free from any ferric hydroxide. Allow the liquid to cool; add a considerable quantity of a rather strong solution of potassic hydrate; then treat with chlorine, continuing the current of the gas until the green nickelous hydrate is completely converted into the nickelic hydrate and becomes perfectly black; after which it may be filtered off, and treated in the usual manner for electrolytic deposition.

Alumina from Iron, Nickel, or Cobalt.—Proceed exactly as above, and add a few drops of potassic hydrate to the somewhat turbid yellow solution until it becomes perfectly clear; then boil with the addition of ammonic chloride, when the alumina will be precipitated free from any of the other accompanying metals. The potassic hydrate and cyanide, as well as the sodic hydrocarbonate for this separation, should be tested for alumina and silica, impurities almost invariably present.

Manganese from Iron, Nickel, or Cobalt.—Add excess of sodic hydrocarbonate and potassic cyanide as already directed, and warm gently until the solution—which in presence of manganese has a dirty blue-green colour—becomes pale yellow and quite clear; then allow to cool, add a little potassic hydrate, and precipitate the manganese as peroxide by adding a little peroxide of hydrogen and leaving the solution in a warm place for a few hours. The peroxide, as is usual when precipitated from alkaline solutions, contains alkali, from which it is very difficult to free it by washing, so that it is best to dissolve in hydric chloride and precipitate as carbonate with ammonic carbonate. In order to avoid this inconvenience the cyanide solution may be precipitated by sulphuretted hydrogen, when manganese sulphide is rapidly and completely thrown down, and admits of being easily washed free from impurities.

Iron from Zinc.—Procure a solution of the cyanides as above, and boil the clear solution with an excess of colourless ammonic sulphide until the steam is neutral to test-papers. The zinc is wholly precipitated as sulphide quite free from iron (or nickel and cobalt if present), and in a granular condition, which may be filtered and washed with the utmost ease.

The presence of cyanates or carbonates in the potassic cyanide exerts no influence whatever on the above separations.

March 16, 1888.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON FOR THE MONTH ENDING FEBRUARY 29TH, 1888.

By WILLIAM CROOKES, F.R.S.;

WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford

and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To GENERAL A. DE COURCY SCOTT, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, March 7th, 1888.

SIR,—We submit herewith the results of our analyses of the 169 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from February 1st to February 29th inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

The whole of the 169 samples examined were clear, bright, and well filtered.

Even to a greater extent than during the two preceding months of December and January, the condition of the water supplied to the Metropolis during the past month has been quite exceptional for the period of the year, and was found, indeed, to fall but little short of that observable in the most favourable of the summer and early autumn months. Although the range of variation in the composition of the water of the Thames and Lea is for the most part, save after the occurrence of floods, too small to be of any practical importance, still an extent of seasonal variation, though unusually small during the present season, is commonly to be observed and calculated upon. Doubtless the exceptional condition of the water

throughout the present winter is traceable primarily to the exceptional drought, the habitual coincidence of a high character of the river-supply with the prevalence of drought being one of many general evidences showing the extensive self-purifying power of running water.

Frost also has prevailed almost continuously through the greater part of the month; but the general effect of frost is found to vary considerably, according to the circumstances under which it occurs. When succeeding a flood, it is observed, indeed, to exert a notably prejudicial effect on the process of filtration.

The mean proportion of organic carbon in the Thames-derived supply for February was fonnd to be 0·152 part in 100,000 parts of the water, as against a mean of ·158 part for January, and of 1·60 part for December. A more considerable decrease was at the same time observable in the numbers expressing the quantities of oxygen required for the oxidation of the organic matter present, and in those expressing the degree of colour-tint of the water.

We are, Sir,

Your obedient Servants,

William Crookes.
William Odling.
C. Meymott Tidy.

PROCEEDINGS OF SOCIETIES.

THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

Annual General Meeting, March 1st, 1888.

Address of the President, Dr. Odling, M.A., M.B., F.R.S., &c.

(Concluded from p. 119).

To revert once more to the preamble of the Charter, it is therein declared—"That the said Institute was not established for the purposes of gain, nor do the members thereof desire or seek any pecuniary profit from their membership; but the society aims at the elevation of the profession of consulting and analytical chemistry, and the promotion of the efficiency and usefulness of persons practising the same, by compelling the observance of strict rules of membership, and by setting up a high standard of scientific and practical proficiency." The Institute of Chemistry being now fairly on its way, it is in the power of the general body of Fellows to make it almost anything they please. They may, if they choose, although in despite of the spirit of the Charter, allow it to degenerate into a very inefficient sort of trades-union; or they may more wisely, as well as more rightfully, resolve upon its being so conducted as to raise it to a position of influence and reputation not inferior to that of any existing professional society. Such a result, indeed, is not to be achieved without continuous effort, and possibly even a little self-sacrifice. I do not, of course, speak merely of the pecuniary contribution, now reduced to a very modest figure, which, in order to carry on the work of the Institute, we require to exact from our members. But even with regard to this contribution, the fitting question for the contributor, I take to be, not what does he himself get in return, but in the achievement of what common good does he bear his part. Anyone who permits himself to entertain the question, "What do I get for my guinea?" must, I fear, be regarded only as an encumbrance, and a hindrance to the cause which the Institute of Chemistry was avowedly founded to aid and bring into success. To those of us who are able to look back a score of years and upwards, there are few things more noticeable than the wide-spread development of Professional Chemistry which has taken place within the last quarter of a century. It is still the case, however, though in a less degree than formerly, that certain of the more lucrative branches of professional work are, to a large extent, in the hands of a comparatively small number of persons, whose professional success has further achieved for them no little degree of personal consideration. Socially, they have been recognised as able to hold their own, in every way, with the most eminent representatives of other professions, whether of engineering, or law, or medicine, or literature, or art. That these of our colleagues have done so well for themselves is a matter of congratulation; but they have done much more than that. They have contributed to found, and obtain recognition, for the profession in which they are eminent; whereby no small gain has been achieved for the members of the profession at large. The ever-increasing demand for the services of professional chemists involves necessarily an increase in the sum-total of distributable gain; but we may now look forward also to its more widespread and equable distribution. When it becomes recognised, as it is becoming recognised, that professional chemists, whether scattered throughout the country or accumulated in particular centres, are alike members of a definite learned profession; that, in point of character, cultivation, and training, they have little or nothing to concede to one another; and that the professional guarantee of conduct and capability is the same for one as for another, it will follow necessarily that much of the work now entrusted mostly to a prominent few will be distributed among a more numerous set of persons, recognised as belonging to the same corporate body, and certified by that body to be no less capable of carrying out the work entrusted to them. It is not, however, suggested for a moment that the higher and more general estimation accorded to the status of the professional chemist, which the action of the Institute is calculated to bring about, will be altogether limited in its effects to members of the Institute. The benefit accruing from its action is not of such a kind that those who decline to associate themselves with us will find themselves wholly excluded from participation therein. But still, as the joint influence and reputation of the Institute extends, as we mean that it shall extend, they will, however competent, undoubtedly find themselves more and more heavily handicapped in the race. For however special, in particular instances, may be the work of the professional chemist, and however secluded and self-sufficing may be his habits and nature, occasions will arise in which his work, and views, and interests will come into collision with those of others; and in which the circumstance that he is not recognised by the great body of his profession as one of themselves, will be likely to tell heavily against him. On the other hand, all of us are liable at times to find ourselves in circumstances of professional difficulty and anxiety,—circumstances in which the sympathy and co-operation we are able to claim from those with whom we are associated as members of a commom professional body, is calculated to afford us no little solace; while the consideration shown to us on all hands, by reason of the professional position we are recognised to hold, may even furnish us a material support. Having regard, moreover, to the many occasions in which professional chemists have to co-operate with or oppose one another, there can be no doubt that their co-operation is rendered more hearty, and their opposition to one another more temperate and kindly, by the circumstance of their owning a common allegiance to, and taking a common interest in, the professional corporation of which they are alike members.

As regards the means by which "the elevation of the profession of consulting and analytical chemistry" may be best promoted, the particular means chiefly dwelt upon in the Charter is the requirement of evidence from all persons, hereafter desirous of entering the chemical profession by becoming successively Associates and Fellows of the Institute of Chemistry, that they have undergone a thoroughly efficient training; and that they possess both a practical and scientific knowledge of the subject of their

professional work. To what extent the requisite training can, or cannot, be satisfactorily afforded and guaranteed in private laboratories is a question on which I forbear to indicate any opinion; more especially as the matter is not one that has come under the formal notice of the Council during my tenure of office. It is likely, however, to be brought before long under the notice of the new Council; who will, I feel sure, be prepared to give it their most considerate attention, and to deal with it in a spirit of liberality, and of thoughtfulness for the best interests of the Institute and of its present and prospective members. But quite irrespectively of whatever conclusion may be come to on this vexed question, and in view of the fact of our requiring from our associates a high degree of scientific as well as of practical knowledge, we must all recognise, as a matter for congratulation, the warm interest taken in the success of the Institute, by the professors and teachers of chemistry at our different universities, colleges, and schools. We are under no small indebtedness to them for directing the attention of their classes to the advantages resulting from admission to our associateship, and for encouraging and enabling the most promising of their students to fulfil our examinational and other requirements. The strongly held opinion becoming more and more prevalent among educational bodies generally, that mere examination, however carefully conducted, does not of itself afford a satisfactory guarantee of knowledge and training, would seem to have a more especial warrant in the case of almost all subjects of practical and professional study; and is one with which the Council of the Institute is heartily in accordance. And, as regards our future Associates, indeed, it is hoped that with the co-operation of professors and teachers, means may be found of supplementing the evidence of attainment now afforded by examination, by further special evidence of training obtainable by certified records of laboratory work gone through.

Passing to another topic, the suggestion has frequently been made that, partly with a view to bringing the members of the Institute into more of personal communication with one another, and partly with a view to effecting advances in the knowledge of those branches of applied chemical science with which the professional chemist is chiefly concerned, occasional meetings of members of the Institute might advantageously be held, at which subjects of interest should be brought forward, in the form of papers or otherwise, and be considered and discussed at the meeting. There is admittedly nothing inconsistent in a professional society taking upon itself the additional functions of a scientific and publishing society; while, as to the desirability of more frequent occasions being afforded for our meeting with one another, there can, I think, be only one opinion. But the occasions, in order to be taken advantage of, must be real occasions, called forth to meet the exigencies of a real want. And it seems difficult to suggest any considerable choice of subjects within the domain of applied chemistry, which could not more fittingly be brought forward at meetings of the Chemical Society, the Society of Chemical Industry, or the Society of Public Analysts, than at any specially called meetings of our own; while an addition to the number of publications in which chemical memoirs have to be sought for, cannot, at any rate, be regarded as a wholly unquestionable good. It will be, however, for the new Council, on any representation made to them, to determine whether it would be possible, with advantage, to set aside one or two evenings a year for the consideration of specified questions of applied chemistry having a sufficiently wide professional interest to be likely to prove attractive to any large number of our Fellows,—specially concerned, as so many of them are, in their own particular departments of chemical work.

One further matter, a strictly personal one, alone is left for me to touch upon. It devolves on me now to take my presidential leave of you. Alike under the articles of the original Institute, and under the bye-laws of our now chartered corporation, the office of President of the Institute is tenable only for a period of three years in succession. As a matter of fact, it has been my privilege to occupy that position for a period of five years; and so to have had the responsibility of delivering on five occasions a more or less lengthy—I fear, sometimes, a too lengthy—presidential address; and on this point, I would venture to remark that the duty of delivering presidential addresses does not belong to the class of duties which become easier of fulfilment by dint of frequent repetition. This, my lengthened tenure of office, however, though contrary to the spirit of our regulations, has been practically unavoidable, by reason of the transitional state through which we have lately passed; and has, I need scarcely say, been strictly in accordance with special provisions made in the Charter for tiding over the period of transition. Technically, indeed, I am still eligible for yet another two years' occupancy of the presidentship. It has been very properly felt, however, that in our present state of successfully achieved position, and quietly persisting progress, there is, in respect to the office of President, no further call for any departure from established custom. It is, indeed, a subject of gratification to the retiring Council, in calling to mind their continuous, and by no means trivial, past labours, to note the steady advance of the Institute in all the material conditions of well-doing. We have been granted our Charter, and have paid all incidental expenses; we have made and obtained allowance for our bye-laws; we have largely increased our number of Fellows and Associates; we have considerably augmented our capital; and we have halved the amount of our annual subscriptions; altogether, I think, a not unsatisfactory record to look back upon.

My tenure of office, now coming to an end, must necessarily be memorable in the annals of the Institute, by reason of its embracing the period of our incorporation by Charter; and will not, I think, be without some personal memories on the part of those, at any rate, who participated in our greatly successful festival held in celebration of that event some two years ago. For myself, I can only say that if the period of my presidency has been at times an anxious and an exacting one, it has been rendered one ever to be dwelt upon as a subject of pleasing recollections, by the willing aid and kindly good will I have throughout experienced at all hands,—from my predecessors in the chair, from the Secretary and Treasurer, from the executive Councils with whom I have been associated, and from the general body of the Fellows. But the position of President of the Institute of Chemistry, however distinguished and gratifying one may feel it to be, is far from proving, or being likely to prove, a sinecure. When five years ago I most willingly, if somewhat rashly, accepted the invitation made to me to be put in nomination for the office, I confess that I somewhat under-rated the duties and responsibilities attaching thereto. I was aware of the labour and pains that had been bestowed upon the affairs of the Institute by successive Councils, and of the promising condition to which it had been brought by their efforts. I remembered the warm interest and unsparing thoughtfulness that had been expended by our first President, Dr. Frankland, not only in aiding the foundation of the Institute but in directing also the early stages of its career; nor could I be less mindful of the patient effort and ready judgment with which it was steered by my immediate predecessor, Sir Frederick Abel, through the choppy seas it had to encounter in its further progress. I knew to what a position of then present security and assured future prospects the Institute had been raised under his skilful guidance. And as it chanced that for some time before my nomination I had not served on the Council, I came to the conclusion, when thinking over the efforts and successes of my predecessors, that there was but little left for me to do; and that, following in the path their labours had marked out, I had a comparatively easy prospect before me. I fancy, however,

that the responsibilities of the position will scarcely be thought to have proved less onerous in my case than in theirs, while they have certainly been of longer duration. Indulging in a fresh self-deception with the coming on of my period of retirement, I began, I fear, to entain a sort of jealous thought in contemplating the easy burden that was likely to fall on the shoulders of my successor. But with the yet nearer and nearer approach of my retirement, I began more and more to realise that every successive year is pretty certain to make its full share of weighty demands on the time, and thought, and kindly discretion of whomsoever may fill the position of President; and I congratulate the Institute that these requirements are likely to be fulfilled in so special a degree by the distinguished chemist whom I am glad to see nominated as my successor. The desirability of having the high position of President of the Institute accorded from time to time to representatives of different branches of professional chemistry is one that all will be ready to acknowledge, and in Dr. James Bell we have the most prominent representative of a branch of applied analytical chemistry daily becoming of greater and greater importance. Of the high official position which he occupies it is unnecessary for me to speak; but I may venture to remind you of the warm interest he has ever taken in the affairs of the Institute, and of the services for which we are indebted to him. Besides taking an active part in the work of the Council and its committees, and further helping us so materially on the occasion of our conference at the International Health Exhibition, he did not fail, in the course of our applications at the Privy Council Office, to render us that personal aid which his recognised official position enabled him so effectually to afford. It is to me, as the retiring President, no small satisfaction to deliver up my office into such worthy and capable hands. For myself, I hope, though now relieved from the responsibility of the Presidency, to be still of some service to the Institute, by taking part from time to time in the more important deliberations of the Council. And I can only regret that the circumstance of my living at a distance from London will, as it must, preclude the possibility of my affording to Dr. Bell that extent of ever-ready co operation and counsel which has been so continually extended to me by my distinguished predecessors, Dr. Frankland and Sir Frederick Abel, and, I would add, by my colleague, Mr. Carteighe, the much-esteemed President of the Pharmaceutical Society. To these, as indeed to all of my friends on the successive Councils, by whom, during my long period of office, it has been my good fortune to be so loyally supported, I have, in now bidding them good-bye, to tender the expression of my warmest thanks.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, March 5, 1888.

Edward Woods, Esq., M.Inst.C.E. and Vice-President, in the Chair.

The following were elected Members:—Frederick Beer, Thomas Buckney, F.R.A.S., the Hon. Justice Day, J. E. Drower, George Beloc Ellis, David Charles Guthrie, Robert George Hobbes, Graham Hutchison, J.P., Mrs. William Moir, Percival Arthur L. Pryor, Vincent Joseph Robinson, Alfred Richard Sennett, Louis Sterne, George Philip Willoughby.

Seven Candidates for Membership were proposed for election.

The special thanks of the members were returned for following donation to the fund for the promotion of experimental research:—Professor Dewar, £100.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

NOTICES OF BOOKS.

Practical Education, treating of the Development of Memory, the increasing Quickness of Perception, and Training the Constructive Faculty. By Charles G. Leland. London: Whittaker and Co.

In this work, whilst there is much which strikes us as excellent and as worth putting in practice, there is also much about which we cannot feel other than doubtful. Some of these difficulties may be smoothed away by remembering that, whilst we instinctively look upon intellectual education as a training for the task of discovery, the author is aiming at industrial art-work. This difference naturally leads him to assign different relative values to the culture of different faculties of the mind. He begins in his schools by teaching design,—no bad initial step in any case. He rightly rejects the possibility of teaching "trades" to children, but he holds that even very young children can "profitably and pleasantly master the decorative arts." He aptly remarks that "As the flower precedes the fruit, decorative art is developed in a race before it attains proficiency in practical work. Long before men had good axes, knives, or any kind of decent tools, they made jewellery and embroidery superior in design or character to anything produced in modern times." It seems, then, that if the modern child is an abridged reissue of the pristine races of mankind, our modern educational systems, instead of developing, extinguish him, by plunging him into words when he craves to deal with things. This verbalism is the great foe both to art and to science.

The author says that "the average *savage* is not, as regards innate artistic capacity or *intellect*, superior to an English schoolboy." But the schoolboys' innate powers of observation have been crowded out by the the three R's or by the classics.

The following remark needs thundering into the ears of reformers, social and political:—"It is one of the great causes of poverty and suffering in the world that the so-called practical men reject with scorn all branches of industry which are not regular and 'staple.'" "The entire population of Ireland might be employed in the minor arts without glutting the market." And again:—"The great reason why Germany is taking the lead in the world's markets is because she teaches art to her apprentices."

In a succeeding chapter we find protests, more or less explicit, against the *verbalism* of our education:—"The small tailor sends his sons to colleges, where they learn words and nothing more." Again:—"Truly the boast of the great men who have graduated of old from certain American—and we may add English—colleges sounds like a Brinvilliers or a Borgia pointing to her escaped victims as a proof of her humanity."

But who would expect after noting these passages, and indeed after carefully reading the entire "Part First" of this book, that Mr. Leland would consecrate his "Part Second" to "developing memory," and, as it further appears, verbal memory? It is the conviction of most men who consider the subject that the great fault of our present—and still more of our past—educational system is that it has resolved itself too much into the development of verbal memory. Such must, indeed, of necessity be the characteristic of every education which busies itself with words rather than with things. Says the author:—"I have been intimate with a learned Chinese who had passed the great examination of Pekin, and I am confident that, though quite a young man, his memory contained ten times as much as any European I ever met." But "as much" of what? Could this learned Chinese effect any addition to the sum total of human knowledge? And if not, we must pronounce that he had been, like so many examinees, simply wasting his time.

Again we come upon a passage simply reprehensible:—

—"What we read of the scholastic disputations of the Middle Ages, and what we observe of the colossal erudition then current, has often drawn forth the remark that there were giants in the land in those days." But would any of these "giants," or would all of them together, be equal to a tenth part of a Newton, a Darwin, a Liebig, a Lavoisier, or a Faraday? What we have to cultivate is not its power of assimilating, but of originating. In short, we submit that this Part on the development of memory would better have been omitted.

Part III., on "Creating Quickness of Perception," is of much greater importance, though the author seems disposed to lay too much weight upon nurture and too little upon inherited nature. But we do not think that mere "quickness of perception" is a capital point. The first condition in observation is accuracy; that the observer should take in every feature of an object presented to him, overlooking nothing, over- or under-estimating nothing, distorting nothing, and, above all things, not superadding to the phenomena his own conclusions or imaginings. The speed at which this is effected is but a subsidiary matter.

It is with real pain that we see so judicious an author attempting, in opposition to the late Sir Arthur Helps, to defend competitive examination. He forgets that no examination can test a man's power of origination, his mental fertility, and the scope of his resources. Nay, as the man highly endowed in these respects often "crams" badly, he is apt to be rejected in favour of the one whose sole faculties are memory and quickness, and who has readily assimilated the work of others.

We are glad to find, however, that in a subsequent chapter he shows himself fully alive to "the absurdity of endeavouring to stimulate study by competition." To base work or study on the principle of competition is, he urges, "even more injurious than the insane idea of making it amusing."

This work, in spite of certain defects which we have felt it our duty to point out, is as a whole strongly to be recommended.

Report on Indian Fibres and Fibrous Substances exhibited at the Colonial and Indian Exhibition, 1886. By C. F. Cross, E. J. Bevan, and C. M. King, in association with E. Joynson. With Notes on Methods of Treatment and Uses prevalent in India, by Dr. G. Watt, C.I.E., M.B., C.M. Published by authority of the Secretary of State for India. London and New York: E. and F. N. Spon.

The present volume chiefly embodies the results of a laboratory investigation of the vegetable fibres displayed in the Indian Section of the Colonial Exhibition. At a Conference held on June 16th, 1886, Mr. Cross offered to make scientific and practical experiments on the entire series of fibres in the Indian Courts, if samples were supplied, and if the Government of India would undertake to publish the results.

The primary object of the authors was purely scientific, viz., to test on the widest range of substances the methods adopted on the examination of vegetable fibres, and, secondly, to classify the fibres according to the results, if found satisfactory. Along with these scientific aims was the quest for practical results. They point out as something remarkable the fewness of the available fibres actually employed in European manufactures, and raise the question whether this restricted application of raw materials lies in their inherent properties or in the mere incidents of distribution and commerce. Their method of examination depended on the joint application of chemical and microscopical procedures. The operations resorted to consisted in the determination of moisture and of ash in the ordinary manner, hydrolysis under the influence of dilute boiling alkalies, examination of the cellulose, mercerising, nitration, combustion, and acid purification. The minute structure of the fibres is shown in an accompanying series of micro-photographs. Applicability of fibres in the textile arts depends, first, on their fineness; secondly, by the length and diameter of the "spinning unit"; and thirdly, on the length of the ultimate fibre cell.

There are over 300 fibre-yielding plants in India, one-third of which are regularly used by the natives, and perhaps thirty are worth recognition in Britain.

The exports of Indian manufactured goods improved during the year by nearly £1,000,000; jute remained stationary, and the exports of raw silk and wool fell off. British yarns would be more largely consumed in India were it not for the obstinacy shown by our manufacturers in refusing to imitate native qualities. This same obstinacy, as compared with the more accommodating spirit shown by German, French, and American industrialists, militates against British trade in many countries and in many articles.

It is of course impossible for us to follow the authors in their examination of the many fibres which have passed under their examination. An important fact noticed is the correlation of lignification with shortness of ultimate fibre. The authors know of no bast fibre having the characteristic in which the length exceeds 5 m.m. They reject, as not in harmony with facts, the common theory of lignification, "in so far as it accounts for the particular chemical composition of lignified fibre as an overlaying of a pure cellulose with encrusting substances of different composition." They rather conclude that the ligno-celluloses are primary plant constituents in the same sense as the celluloses. They would be glad to see more attention paid, from a technical point of view, to the celluloses isolated from *Calotropis* and *Mardenia*. In the jute class *Sida rhombifolia* is the most deserving of notice, and among the Monocotyledons they place the pine-apple fibre highest.

The Rothamsted Experiments on the Growth of Wheat, Barley, and the Mixed Herbage of Grass Land. By William Fream, B.Sc., F.L.S., &c., Professor of Natural History in the College of Agriculture, Downton, Salisbury. 8vo., 235 pages. London: Horace Cox, *The Field* Office, 346, Strand, W.C.

In the excellent little volume before us we have incorporated, in a convenient, concise, and lucid form, the subject-matter, inferences, and opinions contained in the very extensive and valuable reports relating to the experiments on the growth of wheat, barley, and grass, which have emanated from the universally celebrated experimental station at Rothamsted. The fact that it treats of the work of Lawes and Gilbert will be sufficient to commend it to all agricultural chemists; but this book will be hailed with great pleasure by a still larger section of chemists in search of truths in agricultural chemistry, who cannot spare the time required for the adequate perusal of the numerous voluminous and elaborate original memoirs of these authors, which cover many hundreds of pages, and which are, moreover, in many cases practically inaccessible.

Briefly speaking, the volume treats of the effect exerted on the quantity and quality of the produce and on the soil: —1. By cultivating crops of wheat, barley, and grass without manure, with mixed mineral manure, with ammonia salts, with sodium nitrate, with farmyard and some other organic manures, either alone or mixed together, and in varying proportions. 2. By the character of the season and climatic influences during cultivation. In addition there are chapters on unexhausted manurial residues, on crop statistics, and on botanical points. All these matters are admirably discussed and illustrated, and, being in one volume, the statements can be compared with one another with the greatest facility, more especially as there is a useful index and table of contents, whilst the headings of sections are printed in prominent type.

Turning our attention to some of the points raised and

discussed we are struck by the all-importance of nitrogen, without which no manure produces any appreciable effect on crops of wheat, barley, or grass; by the slow action of this element when in organic combination (as in farmyard manure, rape cake, &c.), therefore large dressings of nitrogen in the form of farmyard manure are required in practice; and by the great potency of ammonia salts and nitrates. But we notice that even this useful element, applied either in excess or when cinereal constituents of the plants are deficient in the soil, gives rise to large but immature crops, since without the supply of food material is complete in all respects plants will not mature properly. Five lbs. of ammonia salts under average conditions will produce an increase of 1 bushel of wheat, whilst a similar increase in a barley crop is obtained by manuring with 2 to 2¼ lbs. of ammonia. It is estimated that only 5 per cent of a wheat crop is derived from the soil, the remainder coming from the air. The strength and stiffness of straw does not depend on a large percentage of silica, but is due to the favourable development of the woody substance. Very interesting are the results obtained by manuring grass land; the remarkable changes in the character of the herbage, and the strange effects on their development, are tersely and vividly set before the reader.

The chapters on the fate of nitrogen and other manure constituents in the soil are of great interest: we see, for instance, in crops of hay manured with farmyard manure equivalent to 1606 lbs. of nitrogen per acre for eight years, only 291 lbs. of this nitrogen is recovered in increase of crop during twenty years; that after that period the soil, to a depth of 27 inches, contains 911 lbs., or 56·7 per cent, of this residual nitrogen, leaving 25·2 per cent unaccounted for and lost: many other similar instances of loss of nitrogen are given.

With regard to other manure constituents the following proportions per cent of the quantity applied in manure reappeared as increase of crop during twenty years or so: —Lime 6 per cent, magnesia 21 per cent, potash 48 per cent, phosphoric acid 33 per cent, silica 22 per cent, and so on. Of the most important, the potash and phosphoric acid, it is observed that they are very little subject to loss by drainage, but the unrecovered residues appear to become "so locked up (or distributed) as to be but slowly available to succeeding crops."

We cannot quite agree with the statement "that there are few really large sources of nitrogenous manures which do not, at the same time, bring upon the land a considerable amount of some of the more important minerals also." We should like to have seen some reference to the milling and food value of wheat grown by different manures; to the malting value of barley from the different plots; and also more about the feeding value of the hay—the only information we find on this point is on pages 166 and 172.

We have not observed any reference to the wheat crops crops obtained in the four-course rotation, or in the experiment where wheat is grown alternately with fallow.

A very useful feature of this book is the numerous Tables, with their accompanying remarks. We think a small Table showing the amount of ammonia required, under various manurial circumstances, to produce an increase of 1 bushel per acre in the barley crop (similar, for instance, to the one given on page 54 for the wheat crop), would have been useful.

This volume we are sure will be found extremely interesting to all who take any interest in the scientific diagnosis of natural phenomena; for here we have the results of half a century's accurate experiment, in one of the most complicated of Nature's operations, set before us in a masterly and clear manner which reflects great credit to the patience, zeal, and astuteness of the author.

The eminent investigators whose labours form the subject-matter of this volume show their appreciation of Prof. Fream's exertions by accepting the dedication of the book.

CORRESPONDENCE.

IS A SAFE A SAFE NOW?

To the Editor of the Chemical News.

Sir,—The notice which appeared under this heading (Chemical News, vol. lvii., p. 121) must strike anyone having charge of the custody of valuables with serious alarm.

One simple and certain remedy is to cover the sides and door of the strong room or safe with a network of insulated wires, which would fuse at a much lower temperature than iron or steel, by which an electrical circuit would be broken and a powerful gong set ringing. Of course the battery or other arrangement should be enclosed in the safe, as well as the gong.

The wires may be as close together as we please; and to prevent the possibility of the fused ends falling on the metal floor of the safe, which would restore metallic contact, a not easily fusible insulator should be employed, or a substance like sulphur may be used, which would insulate by forming a metallic sulphite. Vulcanised rubber over a well-tinned copper-wire, or iron or lead, would be suitable. Fusible alloys have been used for conductors for thief-detectors, fire-alarms, &c., but I believe only experimentally.

Experiments should be made at once in this direction, so as to be prepared for the scientific onslaught on our valuables.

Unfortunately it is that comfortable assurance in security which we indulge in that arms the burglar and scientific thief. It is easily possible that no window or door in a house can be opened without raising an alarm, but, when these arrangements are fitted up, the alarm in a short time becomes a nuisance. The burglar knows this, and reckons on the chance.—I am, &c.

Thomas T. P. Bruce Warren.

Tamworth Villa, Earlham Grove,
Forest Gate.

FAT EXTRACTION APPARATUS.

To the Editor of the Chemical News.

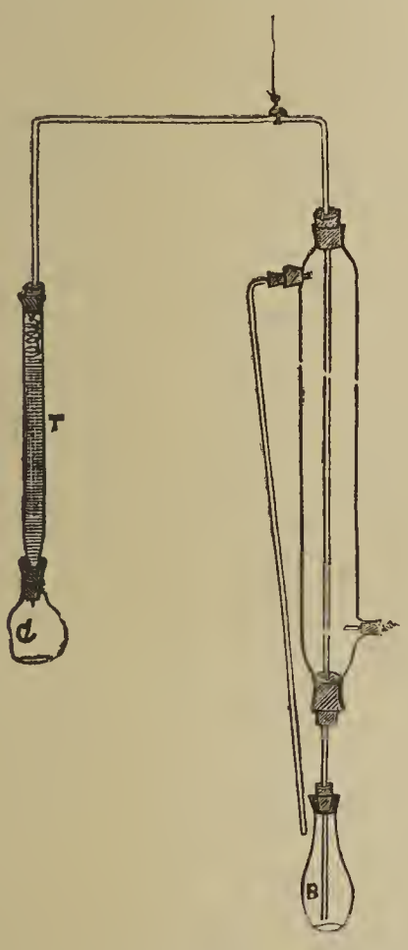
On perusing the description of Mr. Barlow's device and the letter of Dr. Knecht (Chemical News, vol. lvii., pp. 56 and 91), it occurs to me that the apparatus I have used for some time, in preference to Soxhlet's and all others may have some interest for your readers, and I shall be glad if you can afford space for this letter in an early issue.

The contrivance of Mr. Barlow is undoubtedly ingenious, but it seems to me that, besides possessing the failings pointed out by Dr. Knecht, it would be likely to prove a troublesome piece of apparatus to use and to keep in working order. It would, for instance, be a difficult matter to fit and perforate the two corks, C and S, so that the tubes D and V could be manipulated as required without being loose and leaky, or soon becoming so. The general want of neatness and rigidity of the apparatus, and the trouble entailed in working it, are certainly disadvantages of no small account. As an elegant piece of workmanship, combining the maximum extractive effect with the minimum trouble in manipulation, Soxhlet's is the best that I know for samples sufficiently granular to give the solvent free passage. But I have frequently been unable to use it for extracting finely ground materials, in consequence of its admitting of no pressure being applied to the surface of the liquid while being drawn through.

The apparatus I constructed for myself some years ago, and have since used exclusively without accident or trouble, is a modification of Church's apparatus, the essential improvement being in the removal of the danger

of bursting the flasks, or driving out the corks, by pressure during the distillation. The extraction of a sample occupies no more than an hour as a rule, while the recovery of the ether is accomplished, and loss by evaporation is avoided, just as effectively as with any other apparatus.

The tube T—a piece of ordinary combustion tube, drawn out to go through the cork of flask *a*—contains the substance, which is kept in its place by a plug of cotton pushed pretty tightly into the lower end of tube, and, by a more loosely-fitted plug above, held down by a spiral string of common wire. The tared flask *a* is short and wide, with a capacity of 80 to 90 c.c., and is heated in the usual way by a beaker of hot water. Flask B has a similar capacity to *a*, but is preferably of a taller form, and is inserted in a beaker of cold water kept overflowing by a continuous stream from the tap, passing first through the condenser. The tube leading from T to the bottom of flask B is ¼ inch internal diameter, and has no joining. The cork of B has a small V notch opening to the air, to prevent either pressure or rarefaction in the



apparatus as the process proceeds. The whole is suspended by a string attached to any convenient fixture, and can thus be adjusted to make the flasks hang at a suitable height in the beakers. When an extraction is being commenced, 2 or 3 c.c. of ether is put into flask *a*, B is half filled with the same liquid, and the corks are all firmly inserted. The apparatus is now lowered to its normal position, when the ether in *a* is vaporised, expelling the air. The apparatus is now lifted bodily (by taking hold of the condenser), and flask *a* is plunged into a beaker of cold water standing beside the hot one. In a few seconds the liquid ether in B is completely drawn into *a*, carrying along a portion of the oil in the sample. Flask *a* is again inserted in the hot beaker, when distillation commences, and is allowed to continue until the greater portion of the ether be condensed in B: *a* is again dipped in the cold water, and the operation is repeated until the sample be completely extracted.

I find it convenient to use two hot-water beakers, one standing over an argand and ready to replace the other at each new distillation.—I am, &c.,

A. A. Lumsden.

Forth Chemical Works,
Boness, March 15, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 10, March 5, 1888.

Transformation of Nitrates into Nitrogenous Organic Compounds in the Soil. — M. Berthelot. — The author infers from his researches that the assimilation of the nitrogen of nitrates by plants is accompanied, if not preceded, by their transformation into nitrogenised organic compounds in the soil under the influence of chemical reactions and of special microbia. These latter are possibly the same which fix the free nitrogen of the atmosphere in a soil where nitrates are absent. Only if we supply combined nitrogen which is more easily assimilable they take it in preference. In any case two orders of action, distinct if not antagonistic, compete in the vegetable mould. On the one hand the microbia of nitrification tend to convert the ammoniacal salts and the nitrogenous organic matters of the soil into nitrates. Other chemical reactions and other nitrates operate in an inverse direction, reducing these nitrates to the state of nitrogenous organic compounds.

Saccharomyces ellipsoideus and its Applications in the Production of a Wine from Malt. —George Jacquemin.—The author proves experimentally that the elliptical ferment of wine is a stable permanent species, distinct from the ferment of beer. If the former is added to a decoction of malt to which 2·5 per cent of potassium bitartrate has been added (to prevent the invasion of the lactic ferment) the product of the fermentation is a true wine.

Electric Conductivity of Concentrated Nitric Acid. —E. Bouty.—The author considers that all the states of dilution of nitric acid do not contain one and the same electrolyte. Solutions containing from 1 to 4 mols. of water give off at the negative pole hyponitric acid; from this point to that of maximum conductivity there is given off a mixture of gases of which nitrous acid is an element. Solutions from that point to the most extreme dilution give off merely hydrogen.

On Cinchoniline.— MM. Jungfleisch and Léger. — Cinchoniline is an isomer of cinchonine, forming splendid crystals. It is very sparingly soluble in water, freely soluble in ethylic and methylic alcohols, chloroform, benzene, ether, and acetone. It is decomposed by heat, yielding the same products as cinchonine. It reduces potassium permanganate in the cold. It forms basic salts and neutral salts having an acid reaction.

Oxidation-Products of the Hydrazo-camphenes.— C. Tanret. — The author obtains azo-camphene, $C_{80}H_{64}N_4O_{16}$. This compound is obtained in two mutually convertible modifications called, from their colour, cyan-azo-camphene and leuk-azo-camphene.

On Terpinol, an Artificial Reproduction of Eucalyptol or Terpane.—MM. Bouchardat and Voiry.—The terpinol of List is a mixture of inactive crystalline terpilenol or terpol, $C_{20}H_{18}O_2$, boiling at 218°; of terpane, $C_{20}H_{18}O_2$, boiling at 175° and crystallising at −1°, and of inactive terpilene, $C_{20}H_{10}$.

Preparation of Bibasic Glycerinates.—M. de Forcrand.—If 1 mol. of sodium ethylate is caused to act upon 1 mol. of monobasic sodium glyceronate the ex-

change of sodium does not take place below 180°, and is accompanied by secondary decompositions indicating a profound decomposition of the glycerin molecule.

Bulletin de la Société Chimique de Paris.
Vol. xlviii., Nos. 4 and 5, Sept. 5, 1887.

The Constitution and Synthesis of Pilocarpine.—E. Hardy and Gaetan Calmels.—In this lengthy paper the authors describe pilocarpic acid, a new base, pilocarpidine, jaborine, jaboric acid, the products obtained by splitting up jaborine, and its synthesis setting out from β-pyridin-α-lactic acid.

The Chemical Function of Inosite.—M. Lorin.—The author shows that he demonstrated ten years ago the chemical function of inosite as a polyatomic alcohol.

Certain Substances produced by the Action of Hydrochloric Acid Gas upon Glycerin.—MM. Fauconnier and Sanson.—The principal product is a polymer of epichlorhydrine.

Oxidation-Products of the Black Azulmic Matter obtained by the Electrolysis, in an Ammoniacal Solution, of Purified Gas Coke.—A. Millot.—The products obtained are ammelide, cyanuric acid, and ammonium sulphate.

Certain Novel Permanganates.—T. Klobb.—The compounds described are the luteo-cobaltic permanganate, the corresponding chloro-permanganate and bromo-permanganate, and the compound of potassium chloride with the luteo-cobaltic chloride and permanganate.

Practical Analysis of Gases, with Especial Reference to Carbon Dioxide, Carbon Monoxide, and Oxygen.—J. Sinibaldi.—This memoir requires the accompanying figure.

MISCELLANEOUS.

Royal Institution.—The following are the Lecture Arrangements after Easter:—Dr. Charles Waldstein, Three Lectures on John Ruskin; Mr. Walter Gardiner, Three Lectures on The Plant in the War of Nature; Mr. Sidney Colvin, Three Lectures on Conventions and Conventionality in Art; Prof. Dewar, Six Lectures on The Chemical Arts; Prof. T. G. Bonney, Three Lectures on The Growth and Sculpture of the Alps; Mr. Carl Armbruster, Seven Lectures on The Later Works of Richard Wagner (with Vocal and Instrumental Illustrations); Prof. C. E. Turner, Three Lectures on Count Tolstoi as Novelist and Thinker. The following are the probable arrangements for the Friday Evening Meetings after Easter:—Prof. Flower, The Pygmy Races of Men; The Right Hon. Sir William R. Grove, Antagonism; Mr. James Wimshurst, Electrical Influence Machines; Prof. J. K. Laughton, The Invincible Armada: a Tercentenary Retrospect; Mr. W. H. Barlow, Building the New Tay Bridge; Mr. Francis Galton, Personal Identification and Description; Prof. J. A. Ewing, Earthquakes and how to measure them; and a Discourse by Prof. Dewar.

Hofmann Testimonial Fund.—A sum of £255 has been subscribed in this country by the past pupils, friends, and colleagues of Dr. A. W. Hofmann, as an offering to the general fund now being raised in Europe and America as a Testimonial to the Professor on attaining his 70th birthday anniversary, on the 8th of April next. To mark the occasion a Bust has already been executed, which, together with a suitable form of Address and the collected funds, will be presented by a deputation of the German Committee. Subject to approval, it is proposed to devote the available money-balance to the founding of an International Scholarship, which should bear the name of the eminent Professor, who for more than forty years has laboured so successfully, in England and Germany, for the promotion of Chemical Science and the training of his numerous pupils. The British Committee, of which Sir Frederick Abel is Chairman, will gladly receive any additional contributions from those sympathising with the movement, whom it has been found impossible to reach by printed circular. As the date of presentation is so close at hand, intending donors are requested to communicate immediately with—

C. E. Groves, F.R.S., Treasurer, Kennington Green, SE.;
Or John Spiller, F.C.S., Hon. Sec., 2, St. Mary's Road, Canonbury, N.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Earrings.—Is it safe to wear zinc or nickel, commonly called German silver, as earrings? What are the chemical properties contained in these metals?—Maria Tibus.

MEETINGS FOR THE WEEK.

Monday, April 2nd.—Royal Institution, 5. General Monthly Meeting.
Tuesday, 3rd.—Pathological, 8.30.
Thursday, 5th.—Chemical, 8. "Researches on the Constitution of Azo- and Diazo-derivatives. Part III. Compounds of the Naphthaline β-Series." By Prof. R. Meldola, F.R.S., and F. J. East.
Friday, 6th.—Geologists' Association, 8.

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With a Reprint of the Patents Acts of 1883, 1885, and 1886, and Rule and a Summary of the Patent Laws of Foreign Countries and British Colonies.
By JAMES JOHNSON, Barrister-at-Law, and J. HENRY JOHNSON, Assoc. Inst. C.E., Solicitor and Patent Agent, Authors of "The Patentee's Manual."
London: LONGMANS, GREEN, and CO., Paternoster Row.

ST. PAUL'S SCHOOL.—An Examination for filling up about Four Vacancies on the Foundation will be held on the 11th of April, 1888, and following days.—For information apply to Mr. S. Bewsher, Bursar, St. Paul's School, West Kensington.

LONDON HOSPITAL and MEDICAL COLLEGE, MILE END, E.
The SUMMER SESSION will COMMENCE on TUESDAY, May 1st.
The new College Buildings are now complete, and afford more than double the former accommodation.
Students now entering are eligible for the entrance Scholarships in September.
The Hospital contains nearly 800 beds, and is the largest General Hospital in Great Britain.
General fee for Lectures and Hospital practice, 90 guineas in one sum, or 100 guineas in three instalments. The Resident and other Hospital Appointments are free to full Students.
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The property consists of Two Lead Sulphuric Acid Chambers, about 75,000 cubic feet capacity, each Chamber 120 ft. by 24 by 13 ft., adapted for the making of Sulphuric Acid from Pyrites, Spent Oxide, and Sulphur. There are also Salt Decomposing Pot and Condensers for making Muriatic Acid. Workmen's Shops, extensive Tile-covered Sheds, and covered Areas, Buildings, and Office. Stack, 100 feet. Area of land, 5 acres. Rent, £37 10s.
The whole is built at an elevation of 20 feet, thus giving ample space and depth for waste.
For Particulars and Conditions of Sale address Mr. J. E. STEVENS, Solicitor, Swansea.

THE CHEMICAL NEWS.

Vol. LVII. No. 1480.

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ON CERTAIN MECHANICAL PROPERTIES OF METALS, CONSIDERED IN RELATION TO MENDELEEFF'S LAW.*

By W. CHANDLER ROBERTS-AUSTEN, F.R.S.,
Professor of Metallurgy, Normal School of Science, South Kensington.

The author points to the great industrial importance of the influence exerted by small quantities of metallic and other impurities on masses of metals in which they are hidden. He states that this is most marked in the case of iron, and that when Bergman discovered, in 1781, that the difference between wrought iron, steel, and cast-iron depends on the presence or absence of a small amount of "graphite," he was astonished at the smallness of the amount of matter which is capable of producing such singular changes in the properties of iron. The evidence as to the importance of small quantities of impurity is quite as strong in other directions at the present day, as is shown by the statement of Sir Hussey Vivian, that one-thousandth part of antimony converts "best select" copper into the worst conceivable, and by the assertion of Mr. Preece, that "a submarine cable made of the copper of to-day," now that the necessity for employing pure copper is recognised, "will carry double the number of messages that a similar cable of copper would in 1858," when the influence of impurities in increasing the electrical resistance of copper was not understood.

Allusion is made to the effect of a small quantity of tellurium on bismuth. Commercially pure bismuth has a fracture showing brilliant mirror-like planes, but if the one-thousandth part of tellurium be present the fracture is minutely crystalline. Specimens of bismuth are submitted to the Society. The author states that in his own experiments he has employed gold prepared by himself with great care, the purity of which has been recognised by no less an authority than M. Stas. A portion of this gold was recently used by Professor Thorpe in a determination of the atomic weight of gold. Gold was selected for the experiments for the following reasons:—It can be prepared of a very high degree of purity; it possesses considerable tenacity and ductility; the accuracy of the results of the experiments is not likely to be disturbed by the oxidation of the metal or by the presence of occluded gases; and the amount of impurity added to the gold can be determined with rigorous accuracy. The influence of small quantities of metallic impurity in rendering gold brittle has long been known, and is frequently referred to by the older metallurgists, especially by Geber, Biringuccio, and Gellert, and by Robert Boyle. The first systematic experiments on the subject were made by Hatchett at the request of the Privy Council, and were communicated to the Royal Society in 1803. Hatchett concluded that certain metals, even when present in so small an amount as the $\frac{1}{1000}$ part of the mass, will render gold brittle, and he stated that "The different metallic substances which have been employed in these experiments appear to affect gold in the following decreasing order:—1. Bismuth; 2. Lead; 3. Antimony; 4. Arsenic; 5. Zinc; 6. Cobalt; 7. Manganese; 8. Nickel; 9. Tin; 10. Iron; 11. Platinum; 12. Copper; 13. Silver." Mr. Hatchett did not, however, employ pure gold, and in his time the importance of submitting metals to mechanical tests was not understood.

* Abstract o a Paper read before the Royal Society, March 15th, 1888.

The author then proceeds to describe the results of his own experiments, and he states that in selecting tenacity as the test to which the metal should be submitted with a view to ascertain the effect of the added matter, the following considerations presented themselves. W. Spring has built up alloys by compressing the powders of the constituent metals, and by pointing to the evidence of molecular mobility in *solid* alloys, he has done much to show the close connexion which exists between cohesion and chemical affinity. Raoul Pictet considers that there is intimate relation between the points of metals and the lengths of their molecular oscillations, the length of the oscillation diminishing as the melting point increases; and, as Carnelley has pointed out, "We should expect that those metals which have the highest melting points would also be the most tenacious." It is known that the melting points of metals are altered by the presence of small quantities of foreign matter, and their cohesion is also thereby altered. The degree of cohesion may thus be investigated either by the aid of heat or by mechanical stress. It might have been well to ascertain the amount of change in the melting point of gold produced by the presence of the different elements in small quantity, but, unfortunately, slight variations in high melting points are very difficult to determine with even approximate accuracy, and it appeared to be better to ascertain the effect of metallic and other impurities on the cohesion of the gold, as indicated by the amount of force externally applied in an ordinary testing-machine, and in that way to ascertain whether the effect of added metals is amenable to any known law.

The purest gold attainable has a tenacity of 7·0 tons per square inch, and an elongation of 30·8 per cent on 3 inches. Professor Kennedy found that a less pure sample which contained 999·87 parts of gold in 1000, broke with a load of 6·29 tons per square inch; it had an elastic limit of 2·12 tons per square inch, and elongated 18·5 per cent before breaking. In the following experiments only the purest gold that could be prepared was employed. The effect on the tenacity of gold produced by adding to it about 0·2 per cent of various metals and metalloids is shown in the following table, in which the results are arranged according to the tensile strengths:—

Name of element added.	Tensile strength of test-piece. Tons per sq. in.	Elongation. Per cent (on 3 inches).	Impurity. Per cent.	Atomic volume of impurity.
Potassium ..	Less than 0·5	Not perceptible.	Less than 0·2	45·1
Bismuth ..	0·5 (about)	,,	0·210	20·9
Tellurium ..	3·88	,,	0·186	20·5
Lead	4·17	4·9	0·240	18·0
Thallium ..	6·21	8·6	0·193	17·2
Tin.	6·21	12·3	0·196	16·2
Antimony* ..	6·0 (about)	?	0·203	17·9
Cadmium ..	6·88	44·0	0·202	12·9
Silver	7·10	33·3	0·200	10·1
Palladium ..	7·10	32·6	0·205	9·4
Zinc	7·54	28·4	0·205	9·1
Rhodium ..	7·76	25·0	0·21 (about)	8·4
Manganese ..	7·99	29·7	0·207	6·8
Indium*. ..	7·99	26·5	0·290	12·1
Copper. . ..	8·22	43·5	0·193	7·0
Lithium* ..	8·87	21·0	0·201	11·8
Aluminium*.	8·87	25·5	0·186	10·1

Reasons are given for adding the comparatively large amounts of impurity (two-tenths per cent), notwithstanding that even "traces" of certain metals would have produced very marked effects upon gold, and evidence is adduced to show that exact concordance in the respective amounts of matter added to the gold is not of much importance.

The testing-machine is of the form devised by Professor Gollner, and used by him at Prague. It is a double lever vertical machine working up to a stress of 20 tons.

The author points out that these results lead to the

conclusion that the tenacity of gold is affected by the elements in the order of their atomic volumes, and he discusses the evidence in favour of this view at some length, pointing especially to the fact that while those elements, the atomic volumes of which are higher than that of gold, greatly diminish its tenacity, silver, which has nearly the same atomic volume as gold, hardly affects either its tenacity or its extensibility. He shows that so far as the experiments have been conducted, not a single metal or metalloid which occupies a position at the base of either of the loops of Lothar Meyer's curve (which is a graphical representation of the periodic law) diminishes the tenacity of gold, while, on the other hand, metals which render gold fragile all occupy higher positions on Meyer's curve than gold does, and he urges that the relations between these small quantities of the elements and the masses of metal in which they are hidden are under the control of Mendeleeff's law of periodicity, which, as originally expressed, states that "The properties of the elements are a periodic function of their atomic weights." Carnelley has given strong evidence in favour of supplementing the law as follows:—"The properties of *compounds* of the elements are a periodic function of the atomic weights of their constituent elements," and the question arises, "May the law be so extended as to govern the relations between the constituent metals of alloys in which, as is well known, the atomic properties are often far from simple?"

The effect on gold of small but varying quantities of metals, singly and in presence of other metals, demands examination, and their influence on the specific gravity of gold must be ascertained. Until this has been done no explanation as to the mode of action of elements with large atomic volumes will be attempted.

ON THE

DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By ROWLAND WILLIAMS, F.C.S., F.I.C.

HAVING had considerable experience in the examination of opium for the percentage of morphia, I have read with much interest the paper bearing the above title by E. F. Teschemacher and J. Denham Smith, which recently appeared in the CHEMICAL NEWS (vol lviii., pp. 93 and 103).

About two years ago two Persians came to work in my Laboratory, with the object of ascertaining the most reliable method for estimating morphia in opium. When in their own country these gentlemen are engaged in the opium trade, and wished to be able to guarantee the amount of morphia in each consignment before shipment, so as to avoid disputes and allowances as far as possible. My Persian pupils stayed with me about six months, during which period we examined a large number of samples of opium and investigated some of the most promising processes I could find in various works which I consulted on the subject. A short account of a few of our results may perhaps be of interest to some of your readers.

At first we worked almost entirely by the *British Pharmacopœia* process, and our experience was very similar to that of Teschemacher and Smith, viz., fairly concordant amounts of morphia could be obtained from duplicate estimations, but the morphia was by no means pure. We always employed a carefully graduated cylinder, marked at 1040 fluid grains, for measuring the aliquot portion of 1400 fluid grains, as "a wide-mouthed 6-ounce bottle" is obviously quite unfit for such a purpose. In other respects we followed the directions as closely as possible. We were in the same predicament as Messrs. Teschemacher and Smith with regard to taking 1040 grains of the filtrate, as there seems no clear reason why this quantity should be regarded as equivalent to 100 grains of the opium; nevertheless 1040 grains were always used in our estimations. We made two or three dozen determinations of morphia by the B.P. process, but finally abandoned it altogether, as we had already gained sufficient experience to warrant our coming to the conclusion that any method in which lime is employed is, for many reasons, unsuitable for the estimation of morphia in opium.

We next turned our attention to Flückiger's method. Several samples were examined by this method, and it must be admitted that it generally yields very clean white crystals, being in this respect a decided improvement on the B.P. process. This is, no doubt, partly due to the preliminary digestion of the dried opium with ether, which is said to remove narcotin, wax, and colouring-matter, and partly owing to the non-employment of lime, which, I believe, generally produces a dark-coloured morphia. Afterwards we tried the United States Official method, which is in many respects very similar to the B.P. process, and in our hands yielded almost the same results.

In the following Table are given results obtained from four samples when examined by the different methods:—

	Morphia per cent.		
	British.	German.	American.
Sample No. 1 ..	10·8	10·2	11·1
,, No. 2 ..	10·5	10·0	10·8
,, No. 3 ..	7·4	7·1	8·1
,, No. 4 ..	12·2	10·6	11·9

A glance at these figures will show that in every case the German method gave the lowest result, and the American the highest except in Sample No. 4.

Our work in connection with these three processes had by this time convinced me that it was undesirable to take aliquot portions of filtrates, as this mode of operating is undoubtedly liable to cause serious errors. I therefore began a series of experiments in which weighed quantities of the opium were thoroughly exhausted with water, and the extracts concentrated to a syrup, at a gentle heat on the water-bath, before precipitating the morphia. My general plan of procedure was to place 100 grains of the opium in a porcelain basin, add 1000 grains distilled water, and macerate frequently with a rubber-tipped glass rod. The digestion was allowed to go on all night, and the next day the strong aqueous solution of the opium, containing nearly all the morphia, was passed through a Swedish filter, taking care to leave the bulk of the insoluble matter in the basin. This residue was stirred up with several successive small quantities of water (each acting for ten minutes), and the total extract evaporated on the water-bath until it became of syrupy consistence. This was washed into a suitable bottle, using the smallest possible quantity of water for the purpose: 100 grains of alcohol (sp. gr. 0·825) and 300 grains of ether (sp. gr. 0·730) were then added, and the bottle gently rotated for a few minutes. Finally, 30 grains ammonia, sp. gr. 0·880, were added, the bottle frequently shaken, and allowed to stand twenty-four hours. The morphia was then thrown on to a weighed filter, and washed as completely as possible, first with morphiated spirit, and then with morphiated water, as suggested by the late Mr. E. F. Teschemacher. The filter was then dried at 212° F., and the increase of weight represented the amount of crude morphia present in 100 grains of the opium.

Unless I mistake their meaning, Messrs. Teschemacher and Smith appear to be under the impression that they are the only chemists who test the purity of the morphia precipitate by titration with standard acid.

If, however, they refer to the CHEMICAL NEWS (vol. lv., p. 69) they will find a letter of mine respecting Mr. Stillwell's process, in which I distinctly state that, instead of treating the precipitate with hot alcohol, I prefer to check my results by titrating the crude morphia with decinormal sulphuric acid. According to my experience the result, when calculated into pure morphia, generally comes out

about 0·25 per cent lower than the original weight of the precipitate.

During the last few months I have slightly altered my method of estimating the amount of morphia in samples of opium which have occasionally been sent to my Laboratory for examination. I now prefer to work on at least 200 grains of the opium (if that quantity be available), digest all night with ten times the amount of cold distilled water, and eventually completely exhaust with cold water in the manner already described. It will be noticed that I say *cold* water, because I think this preferable to using warm distilled water, as recommended by Messrs. Teschemacher and Smith. There can be no reasonable doubt about cold water extracting all the morphia from opium, and I fail to see the advantage of employing warm water, as there is then a risk of dissolving certain other ingredients of opium, which are more soluble in warm water than in cold. Even if these impurities are removed by the subsequent washings with the various purifying agents, it seems a pity to introduce them at all if their presence can be avoided.

To return to the description of my present method :— The total aqueous extract is evaporated on the water-bath to a small volume, transferred to the precipitating vessel, 100 fluid grains alcohol (sp. gr. 0·825) and 600 fluid grains ether (sp. gr. 0·730) are added, and the whole well mixed by gently rotating the bottle. Afterwards 45 fluid grains ammonia (sp. gr. 0·925) are added, and the remainder of the process conducted as usual.

With regard to the late Mr. E. F. Teschemacher's process, published in the CHEMICAL NEWS (vol. xxxv., p. 47), I must confess that it has always seemed to me to be so complicated that I thought loss must almost inevitably ensue at some stage or other; consequently I have very rarely employed it, but have latterly placed implicit reliance on the method which I have just described, and which I believe gives very accurate results. I propose, however, in the case of future samples of opium, to try the effect of purifying the precipitate of morphia by digestion with benzine, previous to the final weighing and titrating with acid, as Messrs. Teschemacher and Smith attach so much importance to that point.

Messrs. Teschemacher and Smith mention a case in which duplicate samples of opium were submitted to several chemists after being examined by themselves. All these chemists agreed closely with one another, but they found lower percentages of morphia than Messrs. Teschemacher and Smith. As I have good reason for believing that I was one of the analysts in question, perhaps I may be allowed to say that my results were obtained by the process upon which, as already mentioned, I have latterly staked my faith.

Chemical Laboratory, 9, Albert Square,
Manchester, March 24, 1888.

THE VOLUMETRIC ESTIMATION OF IODINE IN PRESENCE OF CHLORINE AND BROMINE.

By NORMAN McCULLOCH.

MONOCHLORIDE and monobromide of iodine are compounds stable in strong solutions of free hydrochloric and hydrobromic acids; and consequently, if to a hydriodic acid solution containing not less than one-fourth, or preferably one-third of its bulk of strong hydrochloric acid, chlorine water, or decinormal permanganate be added, the iodine is completely converted to the monochloride; so—

$$10HI + 2K_2Mn_2O_8 + 22HCl = 4KCl + 4MnCl_2 + 16H_2O + 10ICl$$

and the solution no longer exhibits the characteristic reactions of free iodine.

(The applicability of permanganate to the above purpose will be understood from the well-known reaction of permanganic acid with hydrochloric acid, in which the chlorine of the latter is set at liberty).

On these facts, then, I base my process for the volumetric estimation of iodine in presence of chlorine and bromine, and it will be marked that in principle it closely resembles the chlorine method of Besseyre and Dupré.

This latter process, though aiming at the conversion of the iodine to iodic acid, is adapted neither to the titration of iodine in strong solution, or in any solution containing much *free* hydrochloric or hydrobromic acid, whereas, with the former or my own procedure, practically any quantity of iodine may be conveniently estimated, and in presence, too, of large proportion of hydrochloric or hydrobromic acid, which is really *essential* to the accuracy of the method.

I have operated in my experiments on potassium iodide, the salt being previously dried at 100° C., and standardised by a volumetric method described in "The Estimation of Iodine" (CHEMICAL NEWS, lvii., p. 45). This procedure consisted in dissolving 50 grains of the potassium iodide in 8 ozs. of water acidified with 1 oz. dilute sulphuric acid (one part H_2SO_4 + two parts H_2O), and 1½ ozs. of hydrocyanic acid (3 per cent), and adding thereto a weighed quantity of potassium permanganate (standardised with ferrous ammonium sulphate) with agitation *immediately* following to assist solution of the precipitated iodine and manganic hydroxide. The clear reddish brown colour of the resulting solution was now discharged by further addition of permanganate in standard solution, and then replaced by permanent pink of permanganic acid on complete conversion of iodine to cyanogen iodide, so—

$$10HI + 10HCN + 2K_2Mn_2O_8 + 6H_2SO_4 = 2K_2SO_4 + 4MnSO_4 + 16H_2O + 10ICN.$$

As the result of four almost exactly agreeing experiments the potassium iodide contained 76·00 per cent of iodine.

A weighed quantity of this standardised salt was transferred to a separating funnel of about 8 ozs. capacity, dissolved in a convenient quantity of water, and the solution mixed with its own bulk of strong hydrochloric acid. To this was added 20 or 30 grains (vol.) chloroform, and the permanganate now dropped in, with thorough agitation of the titrated liquid after each addition.

With the progress of the ensuing reaction, the fine violet tint of the chloroform faded as its dissolved iodine changed to the colourless monochloride, and a single drop of permanganate sufficed to completely decolourise the chloroform from a perceptible pink.

I have found that *strong* solutions (about 3 per cent) of iodine monobromide communicate to chloroform a faint yellowish pink colour, but quite distinguishable from the tint peculiar to free iodine.

Results of my experiments are shown in Table I.

TABLE I.

Iodine taken.	Other substances taken.	Iodine found.
15·23	1 oz. HCl.	15·23
2·32	,,	2·31
1·72	,,	1·71
15·25	,, +50 grains KBr.	15·23
0·86	,, ,, ,,	0·86
0·09	,, ,, ,,	0·08

I have investigated the applicability of the above volumetric process to the estimation of iodine in presence of hydrocyanic acid, and, as will be seen from the experiments of Table II., with fairly satisfactory results.

TABLE II.

Iodine taken.	Other substances taken.	Iodine found.
3·13	½ oz. HCl+6 grains HCN.	3·14
3·13	,, ,, ,,	3·13
0·09	,, ,, ,,	0·11
0·61	,, ,, ,,	0·63
0·61	,, 60 grains ,,	0·61

The influence of the hydrocyanic acid is to render the results somewhat high, and, curious to say, to a most marked degree in presence of hydrobromic acid, so much so that the process is not applicable under the circumstances.

I suppose we must attribute this to the formation of cyanogen bromide, a compound of only feeble oxidising powers.

Laboratory of Clyde Iron Works (by Tollcross), Glasgow, March 7, 1888.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

(Continued from p. 124).

Another method of investigating the magnitude of the radius of molecular action is based on the phenomenon of electrolytic polarisation. If we immerse in acidulated water two similar metal plates which are not attacked by the acid, they will be at the same potential. When a current is passed from the one to the other they will, if the metal and acid have been properly chosen, become covered with films of oxygen and hydrogen respectively. The sum of the differences of potential due to metal/gas/liquid, is not the same as that due to the single metal/liquid contact, and varies with the nature of the gas. Hence the coated plates assume different potentials, but the full difference is not established until the surface-density of the deposited gas exceeds a certain value. If then we suppose that the film is uniform, and that the metal and liquid cannot be regarded as completely separated until the thickness of the film exceeds the radius of molecular action, we may by plausible assumptions as to the density of the gas estimate its magnitude.

Thus F. Kohlrausch (*Pogg. Ann.*, cxlviii., 153, 1873), concluded that if the gases are supposed to be at their ordinary densities the polarisation of a platinum electrode is complete when it is coated with a layer of oxygen 20 $\mu.\mu.$ in thickness. It is evident that the assumption as to the density of the gas is totally at variance with the views ordinarily put forward in discussions on the condensation of gases on solids as to the great molecular pressure to which the condensed film is subjected, and that doubt on this point deprives such observations of all value for our present purpose. To reduce the uncertainty as to the density of the polarising layer, it is evidently better to substitute another metal for a gas. This has recently been done by Oberbeck (*Wied. Ann.*, xxxi., 337, 1887).

The films were deposited on platinum electrodes, and the liquids used were solutions of $ZnSO_4$, $CdSO_4$, and $CuSO_4$. Three platinum plates were immersed in the solution which was contained in a rectangular cell. Two plates of the metal of which the sulphate was used (zinc, say) were interposed between the central platinum plate and the other two, and were used as electrodes by means of which a layer of Zn was deposited on both sides of the central plate. Electrolysis was continued until the difference of potential between the coated plate and the external platinums, which were not affected by the current, was the same as that between Zn and Pt (1·13 Daniell). The current was then stopped, and for a time the electromotive force slowly diminished, after which a very rapid decrease was observed. The film was spontaneously redissolved, and the sudden change in the rate of the fall of the electromotive force was regarded as indicating that the thickness of the metallic layer had become less than the radius of molecular action.

If a is the quantity of metal deposited on each sq. c.m. (which could be calculated from the current strength, &c.); and

θ the time which elapsed after the completion of the electrolysis before the rapid fall of E.M.F.,

it was found that these quantities were connected by a relation of the form—

$$a = A + B\theta,$$

where A and B are constants.

Of these A is the quantity of Zn on each sq. c.m., when its thickness is just less than the radius of molecular action, and by means of two experiments in which a and θ have different values it can be calculated. Oberbeck concludes that if the specific gravities of the electrolytic layers are the same as those of the metals under ordinary circumstances, the thicknesses necessary to establish the full difference of potential are between 2 and 3 $\mu.\mu.$ for zinc, between 1 and 2 $\mu.\mu.$ for cadmium, and rather less than 1 $\mu.\mu.$ for copper.

Interesting as these results are, they are open, as Oberbeck himself points out, to criticism. The rapid decrease in the E.M.F. might be explained by supposing that when the zinc layer becomes very thin, parts of the platinum plate are uncovered, and that local action takes place which rapidly dissolves the zinc. This is certain to occur unless the metallic film is uniform. To test its uniformity the experiment was repeated with a solution of acetate of lead as the electrolytic liquid. The colour of the platinum electrode showed that the deposit was uniform over the greater part of the plate, but was slightly thicker towards the edges. No data as to the colours displayed are given, but unless the difference of the tints was very slight it would correspond to a variation of thickness greater than that assigned to the radius of molecular action.

The next method which I propose to describe aims at a measurement of the distance between two consecutive layers of molecules. If plates of Zn and Cu are connected by a metallic wire, they assume different potentials (P and p), the Zn becomes positively the Cu negatively electrified. When the plates are parallel to each other, and separated by a distance t centimetres, they form a condenser, and if $+e$ is the charge upon 1 sq. c.m. the Zn plate $e = (P-p)\,4\pi t$.

Hence et is a constant which depends only on the nature of the metals, and is independent of the distance between them. When the metals are in contact the potential difference remains unaltered, and we may regard the surface molecules as being oppositely charged and separated by a very small interval. The two charges are said by Von Helmholtz to constitute an *electric double layer* (*Pog. Ann.*, lxxxix., 211, 1853; *Wied. Ann.*, vii., 337, 1879).

The mutual action of two metals, or of a metal and liquid when in contact, is therefore the resultant of the molecular forces and the electrical attractions and repulsions which are in play between the different parts of the double layer.

Thus Von Helmholtz (*Berlin Wissenschaft. Abh.*, 925, 1882; see also *Wied. Ann.*, xvi., 31, 1882) has proved theoretically that the surface-tension depends on the electrical charge, and is a maximum when it vanishes, and, as is well known, Lippmann (*Annales de Chemie*, v., 494, 1875) has shown that the surface-tension of mercury in contact with dilute acid is a function of the difference of potential between them, and that every motion of the common surface changes the potential difference in such a way as to produce an alteration in the surface-tension which checks the motion. By means of a theory which it is unnecessary to reproduce here, he (*Comptes Rendus*, xcv., 687, 1882) drew from his experiments the conclusion that for such differences of potential as he employed the capacity of a given area of a Hg/H_2O surface is constant. Hence the distance between the two electrified surfaces is constant, and can be deduced from the theory. The value found is 0·03 $\mu.\mu.$ Oberbeck (*Wied. Ann.*, xxi., 157, 1884) and Falck have measured the electromotive force of polarisation produced by alternating currents on metals immersed in solutions of K_2SO_4, KCl, KBr, and KI. They conclude that the capacity of the double layer is not constant, but is a function of the charge, so that its thickness must be regarded as variable. They deduce, however, its

* A Lecture delivered before the Chemical Society, Feb. 2, 1888.

limiting value when the charge is zero, *i.e.*, the distance between the nearest layers of molecules under normal conditions when no current is passing. The magnitude of this initial value depends more on the metal than on the liquid. The following Table holds for solutions of KCl or KBr, and gives the thickness of the double layer deduced rrom the formula—

$$t = 1/4\pi C,$$

where C is the initial capacity.

Metal.	t in terms of 1 $\mu\mu$.
Nickel	1·04
Aluminium	0·67
Gold	0·06
Silver	0·02

When dimensions so small as these are reached the validity of the method of representing the phenomenon as due to two uniform layers of electricity is very doubtful. The values of t in the case of gold and silver are comparable with the diameters of the molecules themselves, and thus t can only be regarded as a conventional length representing the thickness of an artificial condenser by which the real molecular arrangements may be approximately imitated.

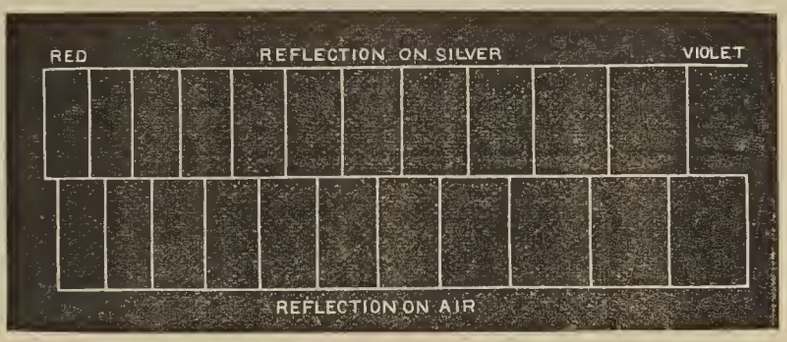
L. Lorenz (*Pog. Ann.*, cxl., 644, 1870) has also based upon electrical theory an estimate of the distance between neighbouring water molecules. He concludes that it is $< 0{\cdot}1\ \mu\mu$.

A very interesting paper has lately been published by O. Wiener (*Wied. Ann.*, xxxi., 629, 1887), in which he attacks the problem of the determination of the thickness of the thinnest metallic plate which affects reflected light in the same way as a thick plate of the same metal.

It is well known that in general when light passes from a less dense to a more dense transparent medium, the phase of the reflected ray is altered by half a wave-length. This is proved by the fact that the centre of Newton's rings as seen by reflected light is black. For the difference in the phases of the rays reflected from the front and back surfaces of the film respectively depends partly on the thickness of the film and partly on any change of phase which the rays may undergo on reflection or refraction. As the film becomes very thin the difference in the paths of the two rays due to its thickness becomes negligible, and thus if the phase were not affected by reflection or refraction, the rays reflected from the centre of the rings where the film is thinnest would be nearly in accord, or the centre would be bright when viewed by reflected light. The fact that the centre is dark is explained by the assumption that when a ray of light passes from a less dense to a more dense transparent medium the phase of the reflected ray is altered by half a wave-length.

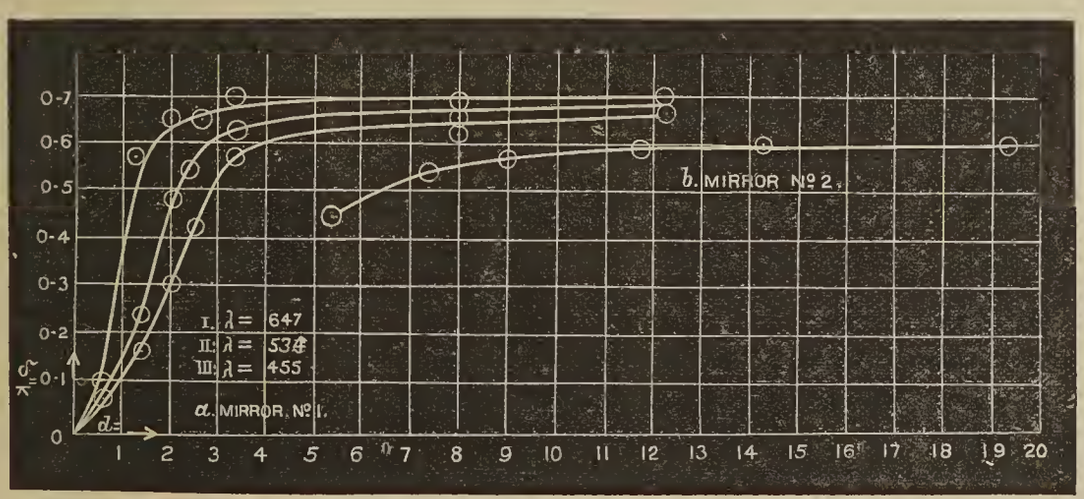
When light is reflected at a metallic surface an alteration of phase also takes place, but it is not necessarily half a wave-length, and it is on this peculiarity that Wiener's method is based.

In the light reflected from a thin film of air enclosed between the two glass plates, those rays will be wanting for which the difference of phase produced (1) by the difference in the lengths of the paths of the rays reflected at the first and second surfaces, and (2) by the change of half a wave-length produced on reflection at the air-glass surface is an odd multiple of half a wave-length. In the spectrum of such light, dark interference bands will be visible corresponding to the missing rays. If the second surface had been silvered (the thickness of the air-film



remaining unaltered) the effect of the first of the above two causes would be the same as before, but that of the second would be different. Hence the particular kind of light for which the total retardation was previously an odd multiple of the half-wave length would no longer satisfy that condition, and the interference bands in the spectrum would occupy new positions. If the second surface had been partly silvered, two contiguous spectra could be obtained in which the interference bands appeared broken.

In the experiments with which we are specially concerned Wiener proceeded as follows:—A thin film of mica was partly covered by a second with a straight-edge. Silver was deposited on it by discharge from a silver electrode (*Wied. Ann.*, xxix., 353, 1886). The layer thus formed was thickest in the centre, and thinned away gradually. When the covering mica was removed the silver film was bounded on one side by a straight line. Thus when light was reflected from the film on to the slit of a spectroscope (the silvered side being furthest from the instrument), two spectra were seen side by side, as is shown in the figure. The displacement of the interference bands varied with the thickness of the film, but became constant when the thickness exceeded a certain value. It was measured for certain parts of the spectrum at a number of points, the positions of which on the mica were determined. The silver was then converted into silver iodide, and the displacement of the interference bands was again determined at the selected points. From this latter measurement the thickness of the iodide, and therefore of the original silver film, could be deduced by formulæ, for the discussion of which I must refer to the



original paper (*loc. cit.*, p. 664). Curves were then drawn, showing the relation between the thickness of the silver and the change of phase produced by it. These are reproduced in the figure. Curves I., II., and III. were obtained by the same mirror, but by observations in different parts of the spectrum. Curve I. corresponds to the orange ($\lambda=647$), II. to the green ($\lambda=534$), and III. to the blue ($\lambda=455$). The retardation increases very rapidly for the blue, less rapidly for the other colours, till a thickness of about 4 $\mu\mu$. is attained. Afterwards it alters more slowly, and is nearly constant at the greatest thickness for which the measurements were made, viz., 12 $\mu\mu$.

Observations made with another mirror confirmed the result that the change of phase reached its maximum value for a thickness of about 12 $\mu\mu$., but indicated a more uniform rate of increase. Herr Wiener ascribes this difference to a slight oxidation of the silver films.

The smallest thickness for which any displacement of the bands could be observed is estimated as rather less than 0·2 $\mu\mu$.

(To be continued).

ON THE OCCURRENCE IN NATURE OF COPPER ANTIMONIDE.

By A. LAIST and T. H. NORTON.

Combinations of copper and antimony have hitherto been known only in the form of the four alloys prepared by Calvert and Johnson,* and Christofle.† Recently a large deposit of an antimonide of copper has been discovered in the eastern part of Asia Minor, not far from Mytilene. We are indebted to the courtesy of Mr. Archag Melcon for samples taken from an extensive vein underlying the entire area of a Turkish village, and easily accessible from the surface.

The new mineral resembles native silver in colour. The freshly fractured surface is quite lustrous, but tarnishes easily, especially in air containing sulphuretted hydrogen. It is of massive structure, no traces of crystallisation or distinct planes of cleavage being detected. It is quite brittle, with very uneven fracture, and in hardness it stands between fluor spar and apatite, *i. e.*, on the scale 4—5. The fusibility in the reducing flame lies between that of antimony glance and of natrolite.

The high specific gravity of the mineral is its most striking physical characteristic. This was found to be 8·812 as the mean of three closely agreeing determinations. It is worthy of note that but a limited number of minerals possess a higher specific gravity.

A qualitative examination showed the sample of the mineral to be a perfectly pure compound of copper and antimony, free from other metals, and also free from gangue.

The quantitative analyses gave the following results :—

	I.	II.	III.	Average.
Cu ..	73·45	73·74	72·92	73·37
Sb ..	27·05	26·90	26·62	26·86
	100·50	100·64	99·54	100·23

The analytical results give figures lying between those required by the two simple molecular expressions Cu_5Sb and Cu_6Sb, and approximate still more closely to the combination $Cu_{11}Sb_2$.

Cu_5Sb.	Cu_6Sb.	$Cu_{11}Sb_2$.	Found.
72·42	75·6	74·39	73·37
27·58	24·4	25·61	26·86

* *Phil. Mag*, (4), xviii., 354.
† "Combinaisons de l'Antimoine avec les Métaux." Göttingen, 863.

"It will be seen that the composition of this copper antimonide is not far removed from the stibio hexargentite variety of dyscrasite, the only native antimonide hitherto known, which Petersen* has shown to exist in two well-defined forms, $Ag_{33}Sb$ and Ag_6Sb.

It seemed a matter of interest to prepare an artificial alloy of copper and antimony of the same composition as the mineral just described. Accordingly 200 grms. of copper and 74 grms. of antimony were fused together in a clay crucible and allowed to cool slowly. The regulus obtained weighed a few decigrms. less than 274 grms., and its composition therefore was—Copper 73 per cent, antimony 27 per cent.

In appearance it closely resembled the native mineral, although not quite so lustrous. It was also more brittle, probably on account of a more rapid congelation. The specific gravity was 8·829,—very slightly higher than that of the mineral, 8·812.

It may be mentioned in this connection that the specific gravity of this antimonide is notably higher than the theoretical figure for a mixture of copper and antimony in the proportions given, viz., 8·19, the difference being 0·622.

A similar fact was noticed by Calvert and Johnson† when experimenting on a combination of the two metals represented by the formula CuSb. The specific gravity found was 7·99, while that calculated was 7·38,—difference, 0·61.

With regard to the metallurgical utilisation of the large Asiatic deposit of this copper antimonide, it is doubtful whether the expense attendant upon the separation of the two metals would permit of successful competition, on the one hand, with stibnite, and on the other hand with the abundant American deposits of copper minerals. Probably the simplest method of treating the mineral would be to expose it to the action of hot dilute sulphuric acid, which would dissolve out the copper and leave an insoluble residue of antimony oxide. Experiment shows us that if an excess of the acid be avoided, all of the copper is extracted, and but a slight amount of antimony enters into solution.

Several alloys containing copper and antimony are used in the arts, and the mineral on account of its purity could be used directly in their preparation.

This new mineral is named Horsfordite, in honour of Prof. Horsford, formerly Rumford Professor of Chemistry at Harvard University.—*American Chemical Journal*, vol. x., No. 1.

AN EASY METHOD OF FINDING THE SPECIFIC GRAVITY OF LIQUIDS.

By ALFRED B. TAYLOR, Ph.M.

A new application of an old rule has suggested a method of finding the specific gravity of liquids which I have never seen mentioned, and which, from its simplicity and great ease of application, seems worthy of publication. By means of it the specific gravity of any liquid can be ascertained without calculation, or any apparatus other than a good balance and accurate weights.

It is known that the weight of a body is to its specific gravity as its loss of weight when immersed in a liquid is to the specific gravity of that liquid. For example :—200 grains of citric acid (sp. gr. 1·60) lose in weight 115 grains when weighed in oil; and as 200 is to 1·60, so is 115 to 0·920 the sp. gr. of the oil. Now if we make the weight of the citric acid the same number of grains as its specific gravity our formula becomes—As 1·60 is to 1·60, so is the loss in weight of the citric acid when weighed in oil to the specific gravity of the oil; or, in

* *Pogg. Ann.*, cxxxvii., 377.
† *Phil. Mag.* (4), xviii., 354.

other words, the loss of weight is equal to the specific gravity, from which we deduce the following general rule:—

The specific gravity of a liquid is equal to the loss of weight (in grains) sustained by a solid body when immersed in the liquid, the weight of the solid being equal (in grains) to its specific gravity.

Hence it is necessary only to weigh the solid in the liquid, and its loss gives at once the specific gravity of the liquid.

Taking the preceding example:—If 200 grains of citric acid lose 115 grains, 1·6 grains will lose 0·920 grain, and this loss is equal to the specific gravity of the oil.

In practice the weight of the solid might be 10 or 100 times the weight of its specific gravity, care being taken to put the decimal point in the right place in the final result.

As perhaps one of the most desirable solid bodies to use, I would suggest a piece of aluminium weighing 256 grains, the specific gravity of that metal being 2·56. If upon trial its specific gravity should vary from these figures, its weight should be made to correspond.

For liquids having greater specific gravity than 2·56, it would be necessary to use a heavier solid than aluminium. —*American Journal of Pharmacy*, vol. lx., No. 2.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN,

General Monthly Meeting, Monday, April 2, 1888.

Sir James Crichton Browne, M.D., F.R.S., Manager, in the Chair.

The following were elected Members:—William Arthur Brailey, M.D., M.A., M.R.C.S., Thomas R. Dallmeyer, Samuel de Lissa, Walter Gilbey, Colonel Alexander Charles Hamilton, R.E., Robert Moon, and Fitzpatrick Praed.

Four Candidates for Membership were proposed for election.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

NOTICES OF BOOKS.

Electrical Instrument-making for Amateurs. A Practica Handbook. By S. R. Bottone. London: Whittaker and Co.

The Preface to this book contains a statement which we are not prepared to accept. Says Mr. Bottone—"Nearly all the really useful inventions and discoveries which have rendered the nineteenth century so remarkable as a season of progress must be attributed to amateurs." With this assertion we are very far from agreeing, if we define the "amateur" as a man who does not make scientific or technical research the object of his life, but merely takes it up in the intervals of business or of amusement. Among practical inventions of unquestioned utility, the coal-tar colours, the Solvay alkali process, the improvements of Weldon and Deacon in the production of chlorine, the achievements of Bessemer and of Thomas and Gilchrist in steel-conversion, can certainly not be ascribed to amateurs. In discoveries, also,—though a discovery is rarely of immediate use,—the great steps taken in advance, such as the discovery of the conservation of energy, the periodic system of the elements, spectroscopy, the artificial production of organic compounds, electro-magnetism, the recognition of organic evolution, are the work of professional men of Science.

Passing over this questionable utterance, we are fully aware that amateurs have done good work, and may do so again, and that they—occasionally at least—develope into professed men of Science. Hence to assist them is a very laudable undertaking. One difficulty, however, remains: the amateur is, at the outset of his career, hampered by lack of time quite as much as by lack of funds. The question may therefore be raised whether he should spend his, perhaps, scanty leisure in manufacturing his appliances?

It seems to us that, in this country, the way of the beginner is made unnecessarily hard by the persistence of makers in giving to many kinds of scientific appliances an outside finish,—an ornamental character,—which adds much more to their cost than to their efficiency.

We by no means question the usefulness of the instruments made according to Mr. Bottone's instructions; but the time required will be a serious object, bearing in mind the occasional failures which are nearly certain to happen, and which will oblige the operator to do his work over again. To many persons, however, this work will be a useful guide, especially as the mere act of constructing the instruments will convey important lessons.

A Text-Book of Inorganic Chemistry. By Prof. Victor von Richter. Authorised Translation, by Edgar F. Smith. Third American from the Fifth German Edition. Carefully revised and corrected. Philadelphia: P. Blakiston, Son, and Co.

In addition to the text-books and handbooks of chemistry produced in this country we import no inconsiderable number of foreign manuals, some translated in England and some in the United States. We believe that in many cases an American writer can make better terms with a Continental author or publisher than can an Englishman, since he is not bound by any International copyright, and can, if he think fit, dispense with any permission.

The special feature claimed for Prof. von Richter's treatise is that it brings into prominence the relations existing between fact and theory. The periodic system is "made the basis of the present volume," and thermo-chemical phenomena are also taken into consideration. In the body of the work the entire discovery of the periodic law is ascribed to Profs. Mendeleeff and Lothar Meyer, who are said to have reached it almost simultaneously. In an Appendix—whether due to the author or the translator we are not certain—the prior claim of Mr. Newlands is admitted.

We must beg leave to differ from the author as to his classification of the sciences, which he divides into "general" and "special." Under the former head he places only mechanics, physics, and chemistry, omitting, it appears, astronomy, and breaking up biology. We think that nothing is gained by this arrangement, even as compared with that of Comte.

Everybody's Pocket Cyclopædia of Things Worth Knowing, Things Difficult to Remember, and Tables of Reference. London: Saxon and Co.

This little work certainly contains many things worth knowing, along with some others certainly not worth knowing, and a sprinkling of errors. Thus, in the first heading, "Historical Events, Handy Facts, and Notable Discoveries," we find it stated that "Daguerre and Nieper invented the process of Daguerreotype." It should be "Daguerre and Niepce."

On the same page we are told that the "electric light was invented by Lodayquin and Kossloff, at London, in 1874." Electric lights had been produced and exhibited long before that date and without the concurrence of the persons mentioned.

Further, "St. Elias, Rocky Mountains, is the highest peak in North America, 17,850 feet." A recent American authority gives its height as 19,500 feet.

Among antidotes for poisoning we find "milk or white of eggs in large quantities" recommended for sugar of lead or lead-water. A soluble sulphate, such as Epsom salts, will be preferable, as converting the lead into the almost insoluble sulphate. Cobalt is a substance so rarely met with that to prescribe an antidote in case of its use seems needless. On the other hand, a remedy for the effects of potassium cyanide would have been useful.

There is a Table giving the "common names of chemical compounds." Here we find chloroform described as "chloride of gormyle," doubtless a typographical error for formyle. Glucose is said to be the "common name" of grape-sugar. These two names would be improved by inversion. It would be well if the name "grape-sugar" were confined to the natural product, whilst the artificial compound — glucose *plus* impurities — should figure as starch-sugar. The "chemical names" here given are not, as a rule, those met with in modern text-books.

The Table of the Stature of Giants makes strong demands upon the reader's faith. We shall believe that De Vallemont (of Rouen) was 17 feet in height, Count Bucart (of Dauphiné) 22½ feet, Teutobach the same height, and an unknown of Palermo 30 feet, when their skeletons are produced.

Under "Origin of Great Inventions" we find the "circulation of the blood" (a discovery, not an invention!) ascribed to Servetus and Cinalpinus (Cæsalpinus?), and only "fully described" by Harvey. The electric light is here ascribed to Davy in 1813, which disagrees with a statement on an earlier page.

There is a list of the "100 greatest men of the world." This includes only twelve men of Science; among them we do not find Liebig, Faraday, or Darwin.

Under "Fifty Well-known People" we find enumerated twenty actors and musicians, and only two men of Science, Professors Huxley and Tyndall.

There are many other defects and errors in this little book to which we have not space to advert, but we may say that a revised and corrected edition would be of unquestionable use.

CORRESPONDENCE.

THE USE OF THE WORD "ASSAY."

To the Editor of the Chemical News.

SIR,—In their paper "On the Determination of the Amount of Morphia present in Opium," Messrs. E. F. Teschemacher and J. Denham Smith write (CHEMICAL NEWS, vol. lvii., p. 104):—"May we ask why Mr. Allen employs the term 'Assay of Morphia,' &c.? Do not let us Englishmen corrupt our own language. Surely 'assay' to a chemist involves the idea of furnacing of some sort."

Without contending that my view is necessarily the correct one, I may say that I give the word "assay" a somewhat broader signification than that adopted by Messrs. Teschemacher and Smith. My own ideas are expressed in the following words, which I quote from my "Commercial Organic Analysis," vol. i., p. 1:—

"The term 'analysis,' though originally meaning the separation or splitting up of a substance into its constituent parts, has now become greatly extended in its application, so that a process of chemical analysis may mean either—

"*a*. A true analysis, or separation of a substance into its constituent parts;

"*b*. A qualitative identification or recognition of a substance sought for; or

"*c*. A quantitative determination, with more or less accuracy, of the amount of a particular body.

"When the quantitative determination is limited to one or two important bodies which constitute the valuable or active constituents of a more complex substance, the analytical process is frequently called an '*assay*.' It is in this sense the term assay is employed throughout this work."

I fully admit that the term "assay" is sometimes restricted to dry methods of analysis, as in the opinion of your contributors it ought to be. In that case, however, what are we to say to the "wet assays" of iron and copper ores? Cannot we have an "assay" of sulphur ore, bleaching powder, or alkali unless the operation is conducted in a furnace? The term "assay" is probably more commonly associated with furnace operations in consequence of these being the first to attain an approximately quantitative character.

In conclusion, I may say that I cannot find in my writings the expression "Assay of Morphia," against my alleged use of which your contributors protest. In fact, unless commercial morphia itself were liable to be tested for the amount of pure or real morphia contained in it—just as commercial anthracene is assayed for the percentage of pure anthracene contained therein—I should not advisedly use the term. On the other hand, the "assay of opium for morphia" is a good example of the way in which I think the term "assay" should be employed.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, March 26, 1887.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 11, March 12, 1888.

On Phosphorus and Phosphoric Acid in Vegetation.—MM. Berthelot and G. André.—The authors conclude that the addition to a soil of phosphoric, and even to a certain degree of nitrogenous manures, after the time of the normal inflorescence of the crop, is useless, or at any rate sparingly fruitful. On the contrary, the addition of potassic manures may be serviceable up to about the cessation of vegetation, seeing that potash continues to be absorbed and to be active as long as the formation of woody matter continues, that is, even during the period of fructification.

A New Eolipyle, devised by M. Paquelin.—The apparatus consists (1) of a receiver of combustible liquid, depressed from above in the form of a circular channel, traversed vertically at its centre by a so-called central tube; (2) of a pipe placed above in the interior of the central tube, and forming a communication between the interior of the receiver and the space outside; (3) a chimney set astride the pipe and forming a continuation of the central tube; (4) a porous body arranged in the interior of the receiver around the central tube, and dividing the receiver into two superimposed chambers, the upper and much the smaller of which is connected with the pipe, whilst the lower chamber contains the combustible matter. This apparatus works with petroleum ether; it has only one flame, is not subject to explosions, and can be used in any position. It gives a jet of flame from 0·15 to 0·18 metre in length, which melts silver, copper, and gold. It consumes only 90 grms. of fuel hourly.

Determination of the Two Red Rays of Potassium.—H. Deslandres—The author has determined the wavelengths of two rays of potassium in the extreme red. The difficulty of the measurement turns on the slight

sensitiveness of the eye for these extreme rays. The use of the arc light has been necessary, and a grating on Rutherford's glass, the primary spectrum of which has a great intensity. With a rather wide slit the two rays are sufficiently visible. They are broad but distinctly reversible. The values adopted for the wave-lengths are: stronger ray, 766·30; fainter ray, 769·63; the mean being 767·965.

The Decreasing Solubility of the Sulphates.—A. Etard.—If the solubility of salts is represented by lines expressing the quantity of matter contained in 100 parts of solution, the author finds that for all the salts which he has had the opportunity of examining, this is a right line, the angular coefficient of which varies with each salt. For any saline matter the line of solubility does not remain constant in its direction. There always occurs a point of time when the angular coefficient changes its value, and even its sign, most commonly abruptly, but at other times after a perturbation more or less prolonged. The change in the sign of solubility is especially well established for the sulphates, and the author gives some new cases of their decreasing solubility.

Action of Roasting upon Several Oxides and Salts of Manganese.—Alex. Gorgen.—The anhydrous protoxides, if heated suddenly and strongly, leave red oxide; if roasted slowly, avoiding incandescence, and kept at dull redness until the weight of the residue is permanent, they yield sesquioxide. If heated to 200° to 430° the oxidation of the MnO obtained at a high temperature is very slow, and does not appear to go beyond manganite. The oxidation of protoxide prepared at dull redness, and effected for the same length of time below 430°, yields a peroxide less rich in oxygen than the sesquioxide. This action of the air between 200° and 430° cannot be studied directly upon protoxides obtained below 400°, since they are pyrophoric, some at 140° and others at common temperatures.

Formation-heat of Bibasic Sodium Glycerinate.—M. de Forcrand.—This paper is not adapted for useful abstraction.

Oxidation-Products of the Hydrazo-camphenes.—C. Tanret.—The author has studied the behaviour of the hydrazo-camphenes with nitric acid, the result being essentially terebenthic acid; also with sulphuric and chromic acids and melting potassa.

Moniteur Scientifique, Quesneville.
Series 4, Vol. i., December, 1887.

The Endosmose of Dutrochet, the Osmotic Analysis or Osmose of Dubrunfaut, and the Dialysis of Graham.—H. Leplay.—In 1826 Dutrochet discovered that if two liquids of different specific gravities are separated by a porous membrane, say a solution of salt on the one side and water on the other, there is set up a double current which he named endosmose, conveying water into the brine, and exosmose, conveying brine into the water. Dubrunfaut observed that of certain salts existing in mixed solution, some traverse an animal membrane more quickly than others, and on this fact he founded osmotic analysis. Graham established the fact that if a crystalline and a non-crystalline substance exist mixed in an aqueous solution, the crystalline body alone traverses the membrane, and on this fact he founded a classification of soluble bodies into colloids and crystalloids—a classification which, in M. Leplay's words "seduced chemists." Dubrunfaut shows the distinction between osmotic analysis and dialysis.

On Hydroquinone.—O. Hesse.—A controversial memoir from *Liebig's Annalen*.

Identity of the Photo-salts of Silver with the Matter of the Latent Photographic Image.—Carey Lea.—Already inserted.

The Struggle against the Phylloxera by Means of Maize.—The writer recommends the planting maize in the vineyards. The phylloxera leaves the vines to attack the maize. This method was proposed by M. Maumené as far back as 1874. It appears that the American vines are being destroyed by the phylloxera as well as the French vines.

Manufacture of Linoleum and of Wax Cloth at Kirkaldy.—From *Engineering*.

On Saccharine.—The *Revue de la Distillerie* points out that saccharine does not ferment, is not assimilated by the organism, and does not constitute a food. Its only legitimate use is in the preparation of medicines or foods for diabetic patients.

On Cholic Acid.—F. Mylius.—From the *Berichte der Deutschen Chem. Gesellschaft*.

On Blue Iodide of Starch.—F. Mylius.—This compound contains an atom of hydrogen replaceable by metals.

Conclusions of Memoir on Rabies.—G. F. Dowdeswell, F.C.S.—A paper read before the Royal Society.

Inauguration of a Monument to Bretonneau, Velpau, and Trousseau at Tours.—The proceedings included the delivery of the customary *éloges*.

Industrial Society of Mulhouse.—Session, Sept. 14, 1887.

O. Scheurer wrote on the substitution of phosphorous acid for arsenious acid in the fixation of iron mordants. He admits that phosphorous acid is less energetic than arsenic, but states that its action is considerable.

Camille Kœchlin observed that arsenic quadruples the fixation of iron.

Session of October 12, 1887.

Camille Kœchlin wished to add to his statement on the effects of arsenic, that this increased fixation takes place only in the presence of alumina.

M. de Haen sent in a sample of a double antimony fluoride and ammonium sulphate, with a request that it might be tried in dyeing and printing. The experiments were entrusted to A. Frey, who was to examine at the same time the double antimony-sodium fluoride of Koepp and Co.

A. Schlumberger sent in a note on tempered mica and its use in the production of paper-hangings.—M. Breuer is about to study its applications in tissue-printing.

M. Binder read a summary of the researches of R. Benedikt, of Vienna, on turkey-red oils.

M. de Kostanecki sent in a note on the preparation of dinitroso-cresorcine, obtained by the reaction of nitrous acid upon cresorcine.

Synthesis of Glucose.—A. E. Tutton.—From *Nature*.

Free Sulphocyanic and Cyanic Acids and their Combinations with Ether and Alcohols.—From the *Journal fur Praktische Chemie*.

Fantastic Chemical Nomenclature.—Dr. Krause.—Under this title the author gives, in the *Chemiker Zeitung*, some well-merited and judicious strictures on such names as antipyrine and antifebrine. He fears that in no distant future we may encounter *contrathermine*, *contraignine*, and the like.

Bulletin de la Société Chimique de Paris.
Vol. xlviii., Nos. 6 and 7, October 5, 1887.

Combination of Glycol with Certain Aldehyds.—H Lochert.—The author has obtained ethylene-œnanthylidene oxide by the reaction of 1 vol. œnanthol upon 3 vols glycol for three days at the temperature of 125° to 130° in a sealed tube. He is making analogous experiments with valeral and isobutylic aldehyd.

Researches on Pheno-safranine.—Ph. Barbier and Leo Vignon.—The authors have taken up the study of pheno-safranine as the simplest of the safranines. They state that the safranines are formed by the condensation

of 1 mol. paradiamine and 2 mols. of an aromatic monamine, with the elimination of $4H_2$ under the influence of oxidising agents. They have discovered a new method of forming substituted safranines founded on the use of nitroso-dimethyl-aniline, and a new method of preparing the phenazines and amido-phenazines, setting out from the aromatic secondary monamines, such as diphenylamine and dicresylamine.

The Oxidation of Silver.—H. Le Chatelier.—The author shows that silver can be directly oxidised, like other metals, and presents in this respect no peculiarity. The tension of dissociation of silver oxide at 300° lies between 10 and 15 atmospheres.

November 5, 1887.

New Reaction of Aluminium Chioride: Syntheses in the Fatty Series.—Alp. Combes.—On throwing gradually into acetyl chloride, kept on the water-bath at 40°—50°, anhydrous aluminium chloride, there is a brisk reaction, which is facilitated by diluting the acetyl chloride with chloroform. Hydrochloric acid is evolved, and there is deposited a solid body, $C_{12}H_{14}O_6Al_2Cl_3$, which must be acetyl acetone. The decomposition of this body yields a liquid boiling at 136°, and having the composition $C_5H_8O_2$. Neither phosphorus trichloride nor acetyl chloride react upon it, even on prolonged boiling,

Derivatives of Acetyl Acetone: Syntheses of Polyatomic Alcohols.—Alp. Combes.—This paper does not admit of useful abstraction.

Action of Oils with Polarised Light.—M. Peter.—The author refers to a memoir on the same subject, by M. Bishop, in the *Journal de Pharmacie*, and to establish his simultaneity gives the results which he has already obtained. In many oils the rotatory power may serve to indicate the presence of foreign oils. In case of olive oil any foreign oils present either increase or diminish its rotatory power. Of all the characters employed in the examination of oils none persists in the free fatty acids: the rotatory power alone gives analogous figures in an oil, and in the mixture of fatty acids or soaps obtained from it.

MISCELLANEOUS.

Chemical Literature.—We beg to call attention to the catalogue of books on chemistry and the allied sciences issued by Mr. Clay, of Edinburgh. We do not believe that any other catalogue at all equal in completeness has been issued in Great Britain. It will be found rich in sets of journals and transactions which it is now very difficult to obtain complete.

The Absorption of Small Amounts of Sulphuretted Hydrogen for Quantitative Determinations.—M. Osmond.—The mixed gases are passed through a bulb apparatus in the several bulbs of which there are placed equal and known volumes of a standard solution of silver nitrate. No hydrogen sulphide can pass into one bulb before all the silver in the former bulb has been precipitated as sulphide.—*Zeitschrift. fur Anal. Chemie.*

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Chemical Designations.—Can you kindly inform me whether there are any restrictions in using the following:—Chemist, Analyst, Research Analyst, Consulting Chemist.—Enquirer.

Gold in Tin.—Can any of your readers inform me if gold is occasionly found in tin, to the extent of several ounces per ton.—H. L.

Earrings.—(Reply to Maria Tibus).—Zinc is usually too brittle for earrings. Nickel silver, an alloy of nickel, copper, and zinc,—called German silver,—though malleable and ductile, sometimes combined with arsenic, is unsuitable to be worn in the ears as rings. for blood poisoning would probably ensue. It is very dangerous to wear earrings which do not contain 24 carats of gold or silver therein, Many vendors of these ornaments merely wash the rings with gold.—Sarah Falbe.

MEETINGS FOR THE WEEK.

Monday, 9th.—Medical, 8.30.
—— Society of Arts, 8. "Milk Supply, and Butter and Cheese Making," by Richard Bannister, F.I.C., F.C.S.
—— Society of Chemical Industry, 8. "The Errors and Defects of the Present Revenue System of Charging the Duty on Spirits and the Means for Remedying them," by Dr. B. Derham.
Tuesday, 10th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Photographic, 8.
—— Royal Institution, 3. "John Ruskin," by Charles Waldstein, Ph.D.
Wednesday, 11th.—Geological, 8.
—— Microscopical, 8.
—— Pharmaceutical, 8.
—— Society of Arts, 8. "Recent Legislation concerning the Pollution of Air and Water," by Alfred Fletcher, Chief Inspector of Alkali, &c., Works.
Thursday, 12th.—Royal, 4.30.
—— Mathematical, 8.
—— Telegraphic Engineers, 8.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.
Friday, 13th.—Quekett Club, 8.
—— Royal Institution, 9. "The Pygmy Races of Men," by Professor Flower, C.B., LL.D., F.R.S.
—— Society of Arts, 8. "The Experiences of Twenty Years in Conducting Agricultural Inquiries in Southern India," by W. R. Robinson, M.R.A.C.
Saturday, 14th.—Physical, 3. "On the Measurement of the E.M.F. of Dynamos," by Prof. W. E. Ayrton, F.R.S., and Prof. Perry, F.R.S. "On the Variation of the Coefficients of Induction," by W. E. Sumpner, B.Sc. "Some Experiments on Soap-Bubbles," by C. V. Boys. "On Electromotive Forces by Contact," by C. D. Burton, B.Sc.
—— Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.

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WILLIAMS and NORGATE, 14, Henrietta Street, Covent Garden, London; and 20, South Frederick Street, Edinburgh.

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TO MANUFACTURING CHEMISTS and OTHERS.

THE METROPOLITAN BOARD OF WORKS will meet at the Office of the Board, Spring Gardens, S.W., on Friday, the 13th day of April, 1888, at 12 o'clock at noon precisely, and will then be prepared to open TENDERS by parties who may be willing to CONTRACT for the SUPPLY of 2000 tons of MANGANATE of SODA, to be delivered at the rate of 100 tons per week from the first week in May next.

Parties desirous to submit Tenders may obtain a copy of the Specification, Form of Tender, and information as to the places of delivery, on application to the Chemist of the Board, at the Office, Spring Gardens, between the hours of 9 a.m. and 4 p.m (on Saturdays between the hours of 9 a.m. and 3 p.m.), until Thursday, the 12th day of April, 1888. The Tenders, which must be on the Form supplied from this Office, and addressed to the Clerk of the Board, are to be delivered at the Office before 4 o'clock on the last-mentioned day, and no Tender will be received after that hour. The parties tendering must be in attendance at the Board at 12 o'clock on the day appointed for opening Tenders, and any Tender which is not fully filled up in every particular will be rejected. The Board do not bind themselves to accept the lowest or any Tender.

J. E. WAKEFIELD, Clerk of the Board.

Spring Gardens, S.W., 29th March, 1888.

THE CHEMICAL NEWS.

Vol. LVII. No. 1481.

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ELECTRIFICATION AND ELECTROLYSIS.

By THOMAS T. P. BRUCE WARREN.

The term "electrification" is applied to two distinct phases of electrical action. The development of electricity by cleavage, pressure, &c., are called methods of electrification (Ferguson's "Electricity," p. 70).

Telegraph engineers use this word to describe a different phenomenon altogether (Warren, *Brit. Assoc. Report*, 1869; *Phil. Mag.*, March, 1870; Jenkins, "Electricity and Magnetism," p. 255; Clark and Sabine, "Electrical Tables and Formulæ," p. 70).

In a paper which was read before the British Association in 1877, on "The Determination of Temperature Coefficients for Insulating Envelopes," this subject was re-examined by the writer. This paper was supplementary to that of 1869. In the sense alluded to here, electrification was applied to the increase of resistance due to prolonged contact with a battery. An insulated wire was said to be electrified for one, two, three, &c., minutes, when connected with a battery for the required time, previous to noting the deflection on a galvanometer due to leakage.

Considering this subject in relation to chemical physics, it is rather unfortunate that the word "electrification" is used in this twofold sense; however, I confine the use of this word to express the physical change in a substance which precedes or is antagonistic to electrolysis.

Electrification may be taken as indicating molecular stress; when a current is passed through a substance which is electrolysed by that current, we may assume that this substance cannot stand the molecular strain and decomposition results.

A substance easily decomposed is termed an electrolyte, one which allows free passage to a current; a conductor, and one which does not conduct (comparatively) at all, is termed an insulator. Now as conduction and insulation are simply comparative expressions for one phenomenon, we are quite right in speaking of the resistances of a conductor and insulator as merely relative.

Clark and Sabine, and the late Prof. Jenkin, are the only writers I have met with who have dealt with electrification in this way. A curious result which has not been specially noted is this: a conductor—like copper, for instance—has its resistance increased by an elevation of temperature, whereas insulators like india-rubber, gutta-percha, resins, oils, and fats, have their resistances diminished; in fact some of these, under certain conditions, are true electrolytes. Again, many liquids which are good insulators in one case become highly conducting, under the same current, when examined in metallic vessels portions of which pass into solution. In such cases the molecular stress has broken down through the presence of a substance which has an affinity for one of the principles contained in the compound insulator.

Hence it is necessary, in measuring the resistance of a liquid or solid, to use electrodes which remain chemically inactive.

The word "polarisation" has been used, unfortunately, in a more indiscriminate way by all writers. Under the action of a current the intervening particles of an insulator between two conductors become polarised by induction, and a sudden return of the particles to their normal condition may give rise to the disruptive discharge, but we must bear in mind that a sudden polarisation due to charging may also result in disruption. To avoid disruption in a highly charged coil the discharge may take place through a resistance, or the charge may be drawn off by instalments into a Leyden jar or condenser, which is then discharged, and the process repeated until the remaining charge can be safely withdrawn.

In this case the molecular stress has been brought about too suddenly. Electrification which can easily be noted on a delicate galvanometer may be taken as a measure of the rate and quantity of molecular stress.

I have no doubt but that a very great deal of information may be gained on the nature of solution, and similar phenomena, by a study of electrification and electrolysis: the behaviour of saline solutions and acids under different degrees of concentration shows that with a feeble current we may produce a change in resistance as if electrification had set in, whereas a stronger current produces unmistakable signs of electrolysis.

Hence in measuring the resistance of an electrolyte the weakest current possible should be used, and in stating the resistance it is of great importance to give the strength of current employed, and, as the *true* resistance of a substance remains constant under different battery powers, we have a means of ascertaining whether electrolysis has set in.

ON THE ALLOYS OF CALCIUM AND ZINC.

By T. H. NORTON and E. TWITCHELL.

A method for obtaining an alloy of calcium and zinc was briefly described in 1860 by Caron.* It consisted in heating together in a closed crucible a mixture of 3 parts calcium chloride, 4 parts zinc, and 1 part sodium. Caron states that by this process he was able to prepare alloys containing from 10 to 15 per cent of calcium.

With the desire of examining these alloys more closely and of testing their availability for the production of metallic calcium, the following experiments were instituted.

In three cases the proportions indicated by Caron were used. In two cases the amount of zinc was diminished by one half. The calcium chloride was first fused, and after congelation finely powdered. The zinc was introduced in the form of small clippings of sheet zinc, and the sodium in small fragments. The mixture was placed in a covered French clay crucible and heated in a furnace or muffle. When zinc flames appeared the temperature was reduced so as to cause a steady but slight volatilisation of zinc. After the lapse of 15—30 minutes the crucible was withdrawn from the fire and broken when cool. The alloy was found at the bottom in the form of a regulus.

The determination of the calcium in the alloys was made in some cases by the use of the "cyanide method," the zinc salt being removed from the mixture of precipitated zinc and calcium carbonates by treatment with a solution of potassium cyanide. In other cases the hydrochloric acid solution was precipitated by ammonia and ammonium sulphide and allowed to settle, when the calcium was precipitated as oxalate from an aliquot portion of the clear liquid.

Experiment I.

The mixture of 40 grms. zinc, 30 grms. calcium chloride, and 10 grms. sodium was strongly heated for 15 minutes. Zinc flames then appeared and the temperature was reduced. After further heating for 15 minutes, during which time puffs of zinc vapour were given off, the crucible was removed. The regulus weighed 18 grms. An analysis by the cyanide method gave—

Ca .. .. 2·28

* *Comptes Rendus*, l., 547.

The specific gravity was 6·8, and the melting-point 360° (the melting-point of zinc). This alloy was difficult to distinguish from pure zinc. It was malleable, and had the same crystalline structure as zinc. The low percentage of calcium was evidently due to the maintenance of too high a temperature during the operation.

Experiment II.

Mixture of 20 grms. zinc, 30 grms. calcium chloride, and 10 grms. sodium. The crucible was introduced into a muffle already heated to a bright red heat. After 25 minutes the crucible was removed. A zinc flame had been apparent during the entire time.

The regulus weighed 21·6 grms.

The analysis made by the sulphide method gave—

Ca .. .. 5·44

The melting-point was about 640°, coinciding very closely with the melting-point of potassium iodide, which was used for a comparative determination. The hardness was 3½.

Experiment III.

The same quantities were used as in the preceding experiment. The muffle was kept for 25 minutes at such a temperature that zinc flames were not evident except when the cover of the crucible was raised.

The regulus weighed 20·7 grms.

The analysis made by the sulphide method gave –

Ca .. .. 6·06

The specific gravity was 6·115. Melting-point about 640°. Hardness 3½. This alloy was of a shining white colour and quite brittle. The lustre did not become dull in the air at the ordinary temperature. At higher temperatures, but still far below the melting-point, it oxidised rapidly. It was not attacked by cold water.

Experiment IV.

The same proportions as in the first experiment were used. The crucible was heated in an open furnace for 30 minutes, zinc being sparingly volatilised during the entire time.

The regulus weighed 39·7 grms.

The analysis by the cyanide method gave—

Ca .. .. 4·97

The specific gravity was 6·24. Melting-point about 640°. Hardness 3½. This alloy had the same physical properties as that obtained in the third experiment. It possessed, however, a marked granular crystalline structure.

Experiment V.

The same charge was used as in the preceding experiment. The crucible was kept in the furnace for forty minutes, a slow volatilisation of zinc being constantly maintained.

The regulus weighed 41 grms.

The analysis by the cyanide method gave—

Ca .. .. 6·36

The specific gravity was 6·369.

The alloy closely resembled that obtained in the third experiment.

Experiments were made to obtain alloys richer in calcium by igniting samples of the alloys already described in porcelain crucibles, in a current of hydrogen so as to expel the zinc. In all cases, however, although zinc was driven off in notable amounts, still there was a proportionate loss of metallic calcium. The residual alloy, rich in calcium, was left in so spongy a condition that it oxidised immediately in contact with the air, and the crucibles likewise showed traces of being attacked.

The results of these experiments would tend to show that it is exceedingly difficult, if not impossible, to obtain by Caron's method zinc-calcium alloys containing more than 6—7 per cent of the latter metal. The notable raising of the melting point, due to the addition of small amounts of calcium to zinc, is worthy of attention.—*American Chemical Journal*, Vol. x., No. 1.

ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

(Continued from p. 138).

We have now reached the point at which we may investigate the inferior limit to the range of molecular forces, viz., the so-called radius of the molecules. This part of my subject has been so fully discussed by Sir William Thomson (*Natural Philosophy*, Thomson and Tait, Part II., 495, 1883; *Proc. Roy. Instit.*, 1883; *Exner's Rep.*, xxi., 182, 1885) and O. Meyer (*Die Kinetische Theorie der Gase*, 225, 1877) that it will be unnecessary for me to reproduce their arguments in full. I shall therefore content myself with shortly stating their results, and describing at greater length a more recent method developed by Dorn and Exner.

Sir William Thomson (*Natural Philosophy*, 502) concludes that the diameter of the gaseous molecule cannot be less than 0·02 $\mu.\mu.$, and that the distance from centre to nearest centre in solids and liquids may be estimated at from 0·07 to 0·02 $\mu.\mu.$

He points out that when plates of Zn and Cu, which are connected by a metal, approach each other, work is done in virtue of the attraction caused by their assuming different electrical potentials. If the plates are split up into an increasing number of thin layers and arranged Zn and Cu alternately, so that the thicknesses of the plates and of the intervening spaces are equal, the work done will vary as the square of the number of plates. If the thickness in question were 0·1 $\mu.\mu.$, the heat-equivalent of the work done would be sufficient to raise the temperature of the metals by 62° C., if it were 0·025 $\mu.\mu.$ the heat would suffice to raise the mass through 992° C. The conclusion is drawn that the molecules of Zn and Cu are probably at least 0·1 $\mu.\mu.$, and certainly more than 0·025 $\mu.\mu.$ in diameter. Again, when a liquid film is stretched, work is done upon it, and it is also cooled. To keep its temperature constant heat must be supplied, and if the thickness were reduced to 0·05 $\mu.\mu.$, the heat-equivalent of the total amount of energy imparted to the film would be about twice the latent heat of steam. As it is incredible that the film could absorb so large a quantity of energy and yet remain in the liquid state, it is certain that if it could be reduced to this extreme tenuity, the work done in stretching it would, *cæteris paribus*, be less when it was very thin than when it was relatively thick. Hence the surface-tension must diminish before the thickness of the film is 0·05 $\mu.\mu.$, and Sir William Thomson thinks that there cannot "be any considerable falling off in the contractile force as long as there are several molecules in the thickness. It is therefore probable there are not several molecules in a thickness of" 0·05 $\mu\,\mu.$ From a consideration of the transmission of light through transparent bodies, he also concludes that the distance between the centres of contiguous molecules in solids and liquids is greater than 0·05 $\mu.\mu.$

The fourth method used by Sir William Thomson is based on the theory of gases. An important formula has been deduced by Clausius, and, in a slightly different form, by Maxwell, which establishes a relation between the diameter of the molecule (d), the mean free path (L), and the ratio of the total volume of the molecules to the volume of the gas (v). It may be written—

$$d = 6\sqrt{2}v\mathrm{L}.$$

The value of v, which is called by Loschmidt the condensation coefficient, has been obtained in various ways.

* A Lecture delivered before the Chemical Society, Feb. 2, 1888.

Sir William Thomson concludes from the general results of experiments on the condensation of gases, that a gas could not be made 40,000 times denser than it is under ordinary atmospheric pressure and at ordinary temperatures. Hence $v > 25 \times 10^{-6}$.

Loschmidt (*Sitzungsber. Wien. Akad., Math. Classe*, lii., Abt. 2, 404, 1866) made use of Kopp's formula—specific volume = molecular weight divided by the density at the boiling-point—to calculate the densities in the liquid state of gases which had not been liquefied. He assigned to the various elements specific volumes somewhat different from those selected by Kopp. Thus assuming those of oxygen and nitrogen to be 11 and 12 respectively, the calculated densities are $16/11 = 1{\cdot}4545$, and $14/12 = 1{\cdot}1666$. Hence, taking air as a mixture of four parts of nitrogen and one of oxygen, he calculated the density in the liquid state to be 1·224. If the molecules are spheres, they will, when packed as closely as possible, occupy a space which bears to the sum of their volume the ratio 1·17 : 1. He assumes that in a liquid they are closely packed, and deduces as an approximation to the true density $1{\cdot}224 \times 1{\cdot}17 = 1{\cdot}5$ say. Hence $v = 0{\cdot}001293/1{\cdot}5 = 0{\cdot}00086$. He takes as the value of the mean free path 140 $\mu\mu$., whence $d = 1$ $\mu\mu$. If, however, we use the value of L given by Meyer (*Die Kinetische Theorie der Gase*, 140), viz., 95 $\mu\mu$., we get $d = 0{\cdot}68$ $\mu\mu$.

O. Meyer (*Theorie der Gase*, 225), employing a similar method for nine substances, the density of which is known both in the fluid and gaseous states by direct experiment, found values for the molecular diameters which lie between 1·18 $\mu\mu$. for N_2O and 0·44 $\mu\mu$. for H_2O.

Dorn (*Wied. Ann.*, xiii., 378, 1881) and more recently Exner (*Rep. der Physik*, xxi., 446, 1885) have obtained the value of the so-called condensation-coefficient, v, in another way.

Clausius (*Die Mechanische Behandlung der Electricität*, iii., Abschnitt) has given a formula which connects K, the specific inductive capacity of a di-electric, and v as above defined, on the assumption that the molecules of the di-electric are conductors, and are surrounded by a non-conducting medium. This formula is—

$$v = \frac{K - 1}{K + 2}.$$

According to Maxwell's electro-magnetic theory of light, if n is the refractive index of the di-electric for rays of infinite wave-lengths $K = n^2$, at all events to a first approximation. This equation is not satisfactorily fulfilled in the case of liquids or easily condensible gases, partly, perhaps, because our knowledge of the law of dispersion is insufficient to enable us to calculate the value of n from the refractive indices of the comparatively short luminous and dark waves which have been studied experimentally. In the case of gases in which the dispersion is very small this difficulty is not met with. As the specific inductive capacity is also very nearly unity the experimental difficulties which attend its determinations are great. The first measurements of this kind were made by Boltzmann and Professors Ayrton and Perry. More recent observations of Klemencic are in good accord with the results obtained by Boltzmann. The agreement between the values of $\sqrt{K}$ and of n, as determined by Mascart, is not satisfactory for vapours, but is very close in the case of the more perfect gases. The following table is abstracted from that given by Klemencic (*Exner's Rep.*, xxi., 611, 1885):—

	$\sqrt{K}$. Boltzmann.	$\sqrt{K}$. Klemencic.	n.
Air	1·000295	1·000293	1·000293
H_2	1·000132	1·000132	1·000139
CO_2	1·000473	1·000492	1·000454
CO	1·000345	1·000347	1·000335
N_2O	1·000497	1·000579	1·000516

This table shows that the value of v may be approximately determined in the case of gases for which we know either K or n. As v is the ratio of the space occupied by the molecules to the total volume of the body, of which the former is a constant and the latter varies inversely as the density (δ) of the substance, it is evident that for each substance v/δ should be a constant. Hence $(n^2-1)/\delta(n^2+2)$ should be the same at all temperatures and for all physical states of the same substance.

This result has been obtained independently from optical considerations by H. A. Lorentz (*Wied. Ann.*, ix., 641) and L. Lorentz (*Wied. Ann.*, xi., 70), and has been tested experimentally by the latter and Prytz (*Wied. Ann.*, xi., 104) in a large number of cases. Although the refractive indices are those for D, and not for waves of infinite length, the agreement is very close.

I give in the following table the first three substances mentioned in the final tables of these two observers as samples. The numbers compared are the values of $(n^2-1)/\delta(n^2+2)$ for the same substance in the liquid and gaseous states:—

Substance.	Observer.	Liquid.	Vapour.
Ethyl ether ..	L	0·30264	0·3068
Ethyl alcohol ..	,,	0·28042	0·2825
Water..	,,	0·20615	0·2068
Methyl alcohol..	P	0·2567	0·2559
Methyl acetate..	,,	0·2375	0·2399
Ethyl formate ..	,,	0·2437	0·2419

The following table contains the values of v for some of the elements. From Avogadro's law it follows that these numbers are proportional to the volumes of the molecules, and if we divide them by the number of atoms in the molecule we obtain numbers proportional to the atomic volumes. In the case of H_2 v was determined from the specific inductive capacity, in all other cases from the refractive index; and this and the next table I quote from Exner:—

Substance.	Molecular volume, $10^{-5} \times$	Atomic volume, $10^{-5} \times$
H_2	8·8	4·4
N_2	20	10
O_2	18	9
Cl_2	51	25
S_4	108	27
P_4	91	23
Hg	37	37
C (from CO – O)	—	14

From these atomic volumes it is of course possible to calculate the molecular volume of any compound of these substances. Thus the molecular volume of water = 8·8 + 9 = 18 nearly.

The following table gives the values of v obtained from K in the cases of the first five substances, and from n in that of the others, together with the calculated values deduced from the above atomic volumes:—

Substance.	v (observed), $10^{-5} \times$	v calculated, $10^{-5} \times$
Air	17*[20]	19
CO_2	31	32
N_2O	33	34
CH_4	31	32
C_2H_4..	44	45
NH_3	26	23
H_2O	17	18
NO	20	19
H_2S	43	36
HCl	30	29
C_2N_2..	56	48
SO_2	44	45

These results on the whole confirm the accuracy of the physical meaning of the expression $(n^2-1)/(n^2+2)$, and

* This number appears to be incorrect. Boltzmann's value for is 1·000590, which gives $v = 20 \times 10^{-5}$. This will be used hereafter.

tend to show that the diameter of the molecule is the same in the liquid and gaseous states. It is important to note, however, that from the theoretical point of view there is a good deal of confusion. The meaning of the expression $(K-1)/(K+2)$ is deduced from an electrical theory put forward by Clausius. It should only be equivalent to $(n^2-1)/(n^2+2)$ when n is calculated for waves of infinite length, and as a matter of fact K and n^2 are not equal for most vapours when n has a value proper to any of the visible rays. If then $(K-1)/\delta(K+2)$ is really the same for a liquid and its vapour, for neither of which n 8 is known, we should not *primâ facie* expect that $(n^2D-1)/\delta(n^2D+2)$ would be the same for both.

Nevertheless experiment shows that the variations produced in this expression, by the passage from the liquid to the vaporous state, are less than the discrepancies due to the imperfect agreement between the values of K and n^2 in the case of most vapours for which both have been determined.

In cases where K is not $= n^2$, the value of v deduced from n^2 is to be preferred. Thus the specific inductive capacity of flint glass, as determined by Dr. Hopkinson (*Proc. Roy. Soc.*, xliii., 161), is 9·5, which makes v nearly $= 0·8$. If we assume the refractive index to have been 1·7, we get v rather less than 0·3, which is in far better agreement with the results obtained from gases. In the case of conductors the values of K are very high.

The annexed table gives the value of v for several liquids, calculated directly from K and n^2, as determined by Dr. Hopkinson (*loc. cit.*). The value is also given deduced from the atomic volumes of the gases, viz., 14×10^{-5} for C, and $4·4\times10^{-5}$ for H. Thus for the substance the chemical formula of which is C_nH_m, we have—

$$v=\frac{(14n+4·4m)\,10^{-5}}{\frac{12n+m}{2}\times0·00008961}\,D,$$

where D is the density of the liquid.

Substance.	Formula.	K.	μ^2.	v(K).	$v(\mu^2)$.	v calculated.
Amylene	C_5H_{10}	2·05	1·9044	0·260	0·232	0·237
Benzol	C_6H_6	2·38	2·2614	0·315	0·296	0·278
Toluol	C_7H_8	2·42	2·2470	0·321	0·291	0·286
Xylol	C_8H_{10}	2·39	2·2238	0·317	0·290	0·284
Cymol	$C_{10}H_{12}$	2·25	2·2254	0·294	0·290	0·295

In these cases, then, all three methods of calculating v indicate that from one-fourth to one-third of the volume of the liquid is filled with matter.

Another interesting point is that this method of regarding the formula $(n^2-1)/\delta(n^2+2)$ enables us to assign a physical meaning to the specific refraction of a substance.

In the above calculations it has been assumed that the atomic volume of a substance is the same, whatever the nature of its union with the other atoms may be. Landolt, however (*Liebig's Annalen*, ccxiii., 1882, 75), has undertaken a careful comparison of specific refractions calculated by the ordinary formula $(n-1)/\delta$ and by $(n^2-1)/\delta(n^2+2)$. He finds that the latter is more constant when the values obtained for the liquid and gaseous states are compared, and he calculates the specific atomic refractions by means of it. He finds it necessary to assign different values to O′ and O″, which, from the point of view we are discussing, indicates a difference of atomic volume. It must also be remarked that a very low value of the specific inductive capacity of air, when the pressure was 0·001 m.m., has been obtained by Profs. Ayrton and Perry, which might, if confirmed by future experiment, affect the questions we have been discussing. The following table of their results is abridged from Ayrton's "Practical Electricity," p. 310. The numbers which refer to air are alone extracted. The letter k indicates that the specific inductive capacity of air at 760 m.m. is taken as unity :—

Approximate pressure in m.m.	k.
0·001	0·994* (about)
5	0·9985
760	1·0000

They have in a pamphlet "On Certain Modifications that must be Introduced in the Fundamental Notions of the Mathematical Theory of Electricity," p. 5, proved that if δ be the density referred to air at 760 m.m. and 0° C. as unity, if 1·000294 be the refractive index of air under the same standard condition referred to that of a vacuum as unity, and if k be defined as above,—

$$k=\frac{0·000588\delta+1}{1·000588}.$$

This expression is obtained by Biot and Arago's formula $(n^2-1)/\delta$ = constant, but a practically identical result will be attained if we use instead the expression employed by Exner. It follows that k has a limiting value when $\delta=0$, such that if k_0 is the specific inductive capacity of a vacuum referred to that of air at 760 m.m. as unity, $k_0=1/1·000588=0·999412$. At 5 m.m. $k=0·999416$, as given by the formula. This agrees with the value obtained by Boltzmann, viz., 0·99941 ("Practical Electricity," *loc. cit.*), but is not in such close agreement with that obtained by Ayrton and Perry themselves. The difference might easily be ascribed to errors of experiment, but the value 0·994, when the pressure was 0·001 m.m., was obtained in a later research (*Rep. Brit. Ass.*, 1880). Its accuracy is independent of that of the measurements at a pressure of 5 m.m., and, as far as I am aware, no other observers have carried out experiments in gases of such extreme tenuity.

It is therefore much to be desired that further observations should be made on the specific inductive capacity of air at low pressures. The importance of such a research would be enhanced from the fact that it has been pointed out by Professor Fitzgerald (*Rep. Brit. Ass.*, 1880, *loc. cit.*) that the values obtained for the capacity of an air condenser between "about 0·02 and 0·2 m.m. pressure bear a general resemblance to those obtained for the Crookes's force." For my present purpose, however, it is sufficient to remark that if the ratio of the specific inductive capacities of air at pressures of 0·001 and 760 m.m. is about 0·994 : 1, then either Maxwell's theory fails when applied to rare gases, or the refractive indices of air at these pressures are in the ratio $\sqrt{0·994}$: 1, *i.e.*, 0·997 : 1. Now the fact that the refractive index from a vacuum to air at atmospheric pressure is about 1·000294, is proved not only by direct experiments on air of different densities, but also by the agreement between the observed and calculated results of the effect of atmospheric refraction on the apparent positions of stars. Hence, if we admit the validity both of the experimental determination of the specific inductive capacity of air, at a pressure of 0·001 m.m., and of the application of Maxwell's theory of this case, we must conclude that the refractive index of highly rarefied air referred to that of a vacuum as unity is—

$$0·997\times1·000294=0·997293,$$

* This number is correct. Prof. Ayrton informs me that that given in "Practical Electricity," viz , 0·94, is a misprint.

and that it is about 0·27 per cent less than that of a vacuum, The alteration in the ordinary refractive index of air which would be required to make this quantity > would make the calculated atmospheric refraction nearly ten times greater than that which is actually observed. It is therefore evident that either the experimental result is affected with error, or that Maxwell's theory does not apply to a rare gas. In either case the conclusions arrived at need not affect the application of Maxwell's theory to substances for which $K=n^2$, and for which, therefore, it appears to be at all events an approximation to the truth.

(To be continued).

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Annual General Meeting, March 28th, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

The President delivered an address, of which the following is an abstract:—

The number of Fellows of the Society is 1571, of whom 37 are honorary foreign members. Eleven Fellows have died during the year:—Prof. C. L. Bloxam; J. B. Boussingault (foreign member); Patrick Duffy; J. J. Field; A. M. Graham; Dr. T. S. Humpidge; James Millar; A. Muter; H. H. MacMunns; W. B. Ritchie; Dr. Arthur Phillips; G. B. Sweeting; and A. E. Wilson.

11 Fellows have withdrawn:—L. M. Deane; H. W. Eve; G. F. Dowdeswell; G. Gladstone; Hugh R. Mill; Ed. Packard; T. A. Rickard; B. M. F. Rogers; C. A. Stitt; J. E. Tuit; and J. C. Wright.

30 Fellows have been removed on account of arrears:—Harry Allen; A. W. Bickerton; G. E. Barker; Dr. H. C. Bartlett; Benjamin Browning; G. E. Basu; C. N. Betts; T. J. Barr; R. D. Courtney; Thomas Donnelly; W. T. H. Elsey; H. W. Fenner; Wm. Fox; Thos. Gibbs; G. A. George; Chas. Gillett; W. E. Heathfield; E. A. Harris; Edwin Lapper; R. T. Matthews; Alexr. Noble; Arthur Ness; O. Davies Owen; J. A. Ogilvie; Thos. Palmer; Matthew Percy; J. Schweitzer; Sidney Trivick; Rev. W. G. Whittam; and Wm. Wilson.

116 Fellows have been elected during the year, including 7 honorary foreign members.

There are 88 original Papers, occupying 871 pages, in the 1887 volume of the Transactions, as against 85 Papers of 865 pages in the 1886 volume. The Abstracts this year occupy 1159 pages, as against 1088 in 1886. The number of Abstracts is 2277, as against 2164 the average of the five years preceding. 108 Papers have been communicated to the Society during the session—10 fewer than in the previous session; but not a few have been of exceptional interest and value, a number of important questions having been brought forward for discussion: this view is confirmed by the fact that the Transactions contain a greater number of Papers than in any previous year.

The Longstaff Medal has been awarded by the Council to Dr. W. H. Perkin, F.R.S., in recognition of the importance of his researches on the magnetic rotatory polarisation of compounds in relation to their chemical constitution. The President said that he was sure the Society would cordially join with him in congratulating Dr. Longstaff that, although he is near the eve of his 89th birthday, he is still hale and hearty, and in expressing the hope that he may long be spared. In bestowing the medal he remarked:—

"It is not often that an opportunity such as that which has fallen to Dr. Perkin's lot is so fully made use of, and that one who has been engaged in industrial pursuits undertakes a research of such magnitude as that of which Dr. Perkin first gave an account to the Society in 1884 (*Trans.*, pp. 421—579), and which it is known has since wholly engaged his attention."

The cost of publishing the Transactions and Abstracts during the past year has been no less than £2116. It is to be expected, said the President, that as the number of Papers offered to the Society multiplies—as it surely will—and as the number of Papers to be abstracted augments, the cost will become even greater. Our publication is of such supreme importance to chemical science in this country, that the Society is not likely to shrink at necessary expenditure. But he felt impelled to refer to a question which ere long must be seriously considered, not only by us, but by scientific societies generally, viz., how far it is desirable that the same Paper should be published in more than one Journal. Our bye-laws only provide that authors shall not be at liberty, save by permission of the Council, to publish in English the papers they have communicated to the Society until such Papers, or abstracts of them, have either appeared in the Journal or have been returned to the writer. It must be taken for granted in this time of culture that a paper published in English, French, or German is thus made known to the entire scientific world, and, in the case of a Paper published in full in one of these three languages, it is unnecessary to give triple repetitions; an abstract of the essential facts, observations, and conclusions would be all sufficient. Some such curtailment will probably find favour, not only as a means of diminishing the cost of publication to individual societies, but also because it will put an end to the grievance undoubtedly felt by subscribers to scientific journals, of paying more than once for the same set of facts.

With perhaps two incomplete exceptions, we have not witnessed during the past session the dawn of any epoch-making, far reaching discovery which opens out new and tempting prospects of truth. The two exceptions are the researches of Krüss and Nilson, and the mathematical discussions of spectra by Professor Grünwald; these latter seem at least to foreshadow the conclusion that hydrogen, oxygen, carbon, and magnesium are not simple bodies but compounds, and if the phenomena admit of no other explanation, and if no unexpected source of error be detected, we may consider ourselves to be within measurable distance of a truly new chemistry. But here time must decide.

The President next drew particular attention to the tardy justice accorded to Mr. J. A. R. Newlands by the award of the Davy Medal of the Royal Society; and he referred to the action taken by Professor Frankland in bringing about the recognition of Mr. Newlands's claim to be the discoverer of the periodic law.

After remarking on the evils arising from the system of competitive examinations, and after deploring the action taken by the London University in making chemistry an optional subject at the Matriculation examination—by certain of the licensing bodies of the medical profession in allowing preliminary training in natural science to be obtained elsewhere than in a college or school with recognised facilities—and by the military authorities in handicapping the study of physical science, the President then proceeded to direct attention to the possible existence of bodies which are not elements in the strictest sense of the word—bodies which he terms meta-elements.*

Dr. Gladstone then moved that thanks be given to the President for his address, and that he be requested to allow it to be printed. The motion was seconded by Dr. Atkinson, and carried with acclamation. The President having replied, the Treasurer, Dr. Russell, gave an account of the financial condition of the Society. The receipts by admission fees and subscriptions had been £3158; by sale of Journal, £351 11s. 1d.: by dividends on invested capital, £317 12s. 9d.; the whole income

* The complete address "On Elements and Meta-elements" will appear in an early number of the Chemical News.

being £3896 2s. 10d. The expenses on account of the Journal had been £2116 10s. 4d.; on account of the Abstracts of Proceedings, £140 15s. 5d.; on account of the Library, £365 7s. 10d.; the total expenditure being £3194 1s. 4d.; £300 had been invested in Metropolitan Board of Works 3½ per cent stock, and there was a balance in hand of £1672 19s. 3d.

Dr. STEVENSON moved that the thanks of the Society be tendered to the Treasurer for his services during the past session; Mr. J. A. R. NEWLANDS seconded the motion. Dr. RUSSELL acknowledged the vote.

A vote of thanks to the auditors was proposed by Professor RAMSAY, seconded by Mr. FRISWELL, and acknowledged by Professor DUNSTAN.

Mr. HEATON proposed a vote of thanks to the Officers and Council; the vote was seconded by Professor DUNSTAN, and acknowledged by Dr. ARMSTRONG.

Professor CLOWES moved that the thanks of the Society be tendered to the Editors, Abstractors, and Librarian for their important services during the year. Dr. PLIMPTON seconded the motion. Mr. GROVES and Dr. THORNE replied.

Messrs. Heron and Jackson having been appointed scrutators, a ballot was taken, and as result the following were declared elected as Officers and Council for the ensuing session:—

President: W. Crookes, F.R.S.

Vice-Presidents who have filled the office of President: Sir F. A. Abel, C.B., D.C.L., F.R.S.; Warren de la Rue, D.C.L., F.R.S.; E. Frankland, D.C.L., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; H. Müller, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; W. H. Perkin, Ph.D., F.R.S.; Sir Lyon Playfair, Ph.D., K.C.B., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: G. Carey Foster, F.R.S.; David Howard; J. W. Mallet, M.D., F.R.S.; H. McLeod, F.R.S.; Ludwig Mond; C. Schorlemmer, Ph.D., F.R.S.

Secretaries: H. E. Armstrong, Ph.D., F.R.S.; J. Millar Thomson, F.R.S.E.

Foreign Secretary: F. R. Japp, M.A., Ph.D., F.R.S.

Treasurer: W. J. Russell, Ph.D., F.R.S.

Ordinary Members of Council: Messrs. T. Carnelley, D.Sc.; A. H. Church; Frank Clowes, D.Sc.; Wyndham Dunstan; P. F. Frankland, Ph.D.; R. J. Friswell; Charles W. Heaton; E. Kinch; H. F. Morley, M.A.; R. T. Plimpton, Ph.D.; Thomas Purdie, B.Sc.; W. Ramsay, Ph.D.

Ordinary Meeting, April 5th, 1888.

Mr. WILLIAM CROOKES, F.R.S., President, in the Chair.

MESSRS. Sidney Skinner, Arthur W. Clayden, and T. A. Elwood were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. John Campbell Fell, 15, Granby Street, N.W.; Albert Harrison, 66, Osborne Road, Forest Gate, E.; Egbert Grant Hooper, 24, Bloomfield Terrace, Buckingham Palace Road, S.W.; John Hughes, 3, West Street, Finsbury Circus; Henry James Kirkman, London Alkali Works, Swansea; William Parsons, 5, Earlsmead Road, South Tottenham, N.; Henry Charles Reynolds, 8, The Avenue, Clifton, Bristol; Frank Goodell Wait, University of Toronto, Canada.

The following papers were read:—

27. "*Researches on the Constitution of Azo- and Diazo-derivatives. III. Compounds of the Naphthaline β-Series.*" By R. MELDOLA, F.R.S., and F. J. EAST.

The authors describe the action of nitrous acid on the azo-compounds produced from the diazotised nitranilines and β-naphthylamine. The products vary according to the mode of operating; if the nitroazo-compound be dissolved in a large quantity of acetic acid and sodium nitrite be added to the cold solution, a diazo-compound is formed, which decomposes normally on boiling the solution, thus:—

$$NO_2\cdot C_6H_4\cdot N_2\cdot C_{10}H_6\cdot N_2\cdot OH = \\ = NO_2\cdot C_6H_4\cdot N_2\cdot C_{10}H_6\cdot OH + N_2.$$

If less acetic acid be used and the temperature be not allowed to exceed 60° to 70° at any stage of the operation, the change is of a different character, the acetic acid itself taking part:

$$NO_2\cdot C_6H_4\cdot N_2\cdot C_{10}H_6\cdot NH_2 + 2C_2H_3O\cdot OH + NaNO_2 = \\ = NO_2\cdot C_6H_4\cdot N_2\cdot C_{10}H_6\cdot OC_2H_3O + N_2 + C_2H_3O\cdot ONa.$$

The details of the methods are given in the paper. The authors propose to make a special study of this last interaction, which promises to be of general application as a means of displacing NH_2 by $-O\cdot C_2H_3O$. Metanitrobenzenazo-β-naphthyl acetate melts at 161° to 162°, and the corresponding paranitro-compound at 192° to 193°.

The authors have also found that the acetyl-derivatives of the azo-β-naphthol compounds can be obtained by direct acetylation by long boiling with acetic anhydride and anhydrous sodium acetate. Metanitrobenzeneazo-β-naphthyl acetate thus prepared is identical with that obtained from the corresponding β-naphthylamine compound by means of the diazo-compound and acetic acid in the manner described. Benzeneazo-β-naphthyl acetate prepared by the acetylation of benzeneazo-β-naphthol forms orange scales melting at 117°. A detailed examination of the products of complete reduction of the acetyl- and alkyl-derivatives is in progress. The authors refrain from expressing any view as to the constitution of the naphthalene-β-azo-compounds till more experimental evidence has been obtained; but point out in conclusion that the present evidence indicates distinctly the presence of hydroxyl and amidogen in the β-oxyazo- and β-amidoazo-compounds of naphthalene respectively.

28. "*The Action of Finely Divided Metals on Solutions of Ferric Salts, and a Rapid Method for the Titration of the Latter.*" By D. J. CARNEGIE, B.A.

Ferric salts, whether in aqueous or acid solutions, are very rapidly, indeed almost instantaneously, reduced to ferrous salts by shaking with zinc-dust. The author describes a simple, very accurate, and very expeditious modification of the method for determining ferric salts by titration with permanganate, founded on this observation. The author considers that the zinc directly reduces the ferric salt, $Fe_2Cl_6Aq + Zn = ZnCl_2Aq + Fe_2Cl_4Aq$. If acid is not present some of the iron is precipitated partly as ferrous and partly as ferric hydroxide.

Many other finely-divided metals, besides zinc-dust, effect the reduction of ferric chloride; in every case examined the heat of formation of the chloride of the metal is greater than the negative value of the thermal change accompanying the passage from Fe_2Cl_6 to Fe_2Cl_4.

DISCUSSION.

Professor RAMSAY remarked that he had for some years past employed zinc-dust instead of granulated zinc or zinc-foil to effect the reduction of ferric salts. When ferric salts are reduced by stannous chloride, the excess of reducing agent can readily be removed by the addition of mercuric chloride to the solution previous to titration with bichromate.

Mr. CARNEGIE stated that the use of powdered zinc had been suggested some years ago by Brown: the reduction, however, took place in the presence of acid, and was not a direct chlorinating process, such as that referred to in the paper.

At the next meeting, on April 19, the following paper will be read:—

"The Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and of Calcium Hydroxide," by W. A. Shenstone and J. Tudor Cundall.

NOTICES OF BOOKS.

The Fundamental Principles of Chemistry, practically taught by a New Method. By ROBERT GALLOWAY, M.R.I.A., F.C.S., Author of "Education, Scientific and Technical." London: Longmans, Green, and Co.

WHAT have we here? One of the many manuals, handbooks, and text-books of chemistry which for the last dozen years have showered from the press, and few of which have any clearly-marked *raison d'être?* Nay, good reader, or worthy outside critic who reviewest scientific works for the lay press! Something clearly different, as a few minutes' careful inspection will show you. For these routine manuals are, with exceptions few as angels' visits, mere abridgments of the great works of reference, such as Gmelin, or Roscoe and Schorlemmer. Such abstracts of encyclopædic treatises are evidently of little use as educational manuals. As the author clearly and forcibly puts it in his Preface, in such works the facts are unclassified; the generalisations are placed apart from the facts, and the technical language of the science is nowhere taught systematically,

Our author, as it will be seen, pursues a different method, and one which in our judgment will prove more profitable to the student. There is not, as Prof. J. P. Cooke puts it, "a weary catalogue of elementary substances involving a repetition of details as profitless to the general student as it is tedious and uninteresting."

In Prof. Galloway's system the facts brought forward are kept in an organic connection, and each is made to teach its lesson, so that the interest of the student is kept up. Thus the study, instead of being a mere burden for the memory, is made an exercise for the reason.

The work begins with a course of physics adapted to the course of pure chemistry which follows.

Thus the explanation of "porosity" is made to illustrate and teach porosity; the collection and storing of gases is shown under "impenetrability"; determination of boiling-points and fractional distillation under "adhesion." It will be remarked that the student is advised to pass over temporarily portions of certain chapters until he has made himself master of the technical language of chemistry as expounded in a subsequent chapter.

We find only two statements which we cannot accept. The author holds it as still uncertain whether fluorine has been obtained in the free state, and the arts of dyeing and tissue printing are explained too exclusively as based upon adhesion.

We hope that Mr. Galloway's work, and indeed his system of teaching, will receive a fair trial, feeling convinced that its advantages will not be slow in making themselves manifest.

A Practical Treatise on Animal and Vegetable Oils and Fats: comprising both Fixed and Volatile Oils, their Physical and Chemical Properties and Uses, the manner of Extracting and Refining them, and Practical Rules for Testing them; as well as the Manufacture of Artificial Butter, Lubricants, including Mineral Lubricating Oils, &c.; and on Ozokerite. Edited chiefly from the German of Drs. Karl Schaedler, G. W. Askinson, and R. Brunner, with Additions and Lists of American Patents relating to the Extraction, Rendering, Refining, Decomposing, and Bleaching of Fats and Oils. By W. T. BRANNT. Illustrated by 244 Engravings. Philadelphia: Baird and Co. London: Sampson Low, Marston, and Co.

THIS work, though running to 700 pages, covers such an extent of ground, that some of the subjects are scarcely treated in as full a manner as it might be desired.

The author opens with an account of the sources of fats and oils, those of vegetable origin being arranged according to the families to which they belong. Here we find a very useful table of the percentages of oil in seeds or fruits, ranging from 60 to 67 in Brazil nuts down to 1 to 1·5 in barley. It will perhaps surprise some readers to learn that the olive ranks low in the list, containing only from 12 to 20 per cent. To this table is premised the remark that the percentage of oils in seeds and fruits is inversely as that of sugar and starch.

The second chapter discusses the physical properties of the fats and oils. It is found that—of course at similar temperatures—fats from tropical climates are as a rule more solid than those from cold climates. The qualities considered are—Consistency (castor oil, *e.g.*, being at 59° F. 203 times more consistent than distilled water), capillarity, odour, taste, colour, and solubility. It is mentioned that fats and oils are not, as commonly supposed, absolutely insoluble in water. The next points considered are—Neutrality,—fatty substances being pronounced neutral to blue litmus,—changes on exposure to air, and combustibility. The table of relative combustibility gives the highest value to plum-kernel and olive oils, and the lowest to black mustard-seed oil. There is also a table of specific gravities.

In the third chapter the author turns to the chemical constitution of fats and oils.

We next come to the methods of obtaining the fixed oils, by pressure and by extraction with solvents, such as carbon disulphide and petroleum ether, the latter having the preference chiefly when the oil is intended for perfumery or culinary purposes.

For purifying oils there is mention of sulphuric acid, zinc chloride, chromates, manganates, &c. Tannin has not been found to give favourable results. The dregs from rendering tallow are now extracted with carbon disulphide, yielding about 10 per cent of an inferior fat, whilst the nitrogenous residue can still serve in the manufacture of glue or ferrocyanides.

The information here given concerning the movements of the cod on the Norwegian coast, and the proportion of cod-liver oil, is not quite correct. The fish appear at the Lofotens in January. It is not brought out with sufficient clearness that all the yellow and brown oils, no matter how carefully treated, owe their colour to incipient decomposition. Hence all such qualities are more or less rancid, and are much more apt to disturb the stomach than the oil in its original colourless state. It is an error to assert that the colourless oils have been artificially bleached. No such statement, however, is made in the work before us. The author, quite correctly, denies that the cod-liver oil is adulterated in Norway. That operation, if performed at all, is executed by importers.

Culachan oil, obtained from *Thaleicthys pacificus*, on the coasts of British Columbia and Alaska, is said to be more easy of digestion than cod-liver oil, but to assume a lard-like consistency even at ordinary temperatures, an inconvenience which might be overcome by removing the stearine.

Space does not allow us to pass in review the subsequent chapters, in which, however, we notice only one error of any moment. The use of cohesion figures as tests for the identity and purity of oils is here ascribed to Miss Kate Crane, with a reference to the *American Journal of Pharmacy* for September, 1874. If the author had referred to the CHEMICAL NEWS for 1868 (vol. xviii., pp. 249, 261, 272, and 299) he would have learnt that the process was devised by Mr. Tomlinson, and that Prof. Emerson Reynolds and Dr. Carter Moffat had been working at its development. It is nevertheless possible that Miss Crane's observations may have been made independently.

The work before us cannot be regarded as other than valuable and useful.

On Isodulcite.—MM. Rayman and Kruis.—Isodulcite has some analogies with arabinose, but it is not, as seemed probable, its methylic ether.—*Bull. Soc. Chim de Paris.*

CORRESPONDENCE.

COMBUSTION APPARATUS.

To the Editor of the Chemical News.

SIR,—Users of the combustion furnace are often annoyed by the breakage of their fire-clay tiles when accidentally let drop. I have found that asbestos card is far superior to the clay tiles, not being subject to this defect. Slabs of this may be cut to any size by using the broken point of some old knife. The material may be obtained, wholesale, in sheets of about 3×4 ft., as low as 4*d*. per lb. A better quality, however, is recommended, as this is very liable to flake.

Compared with the clay tiles it has the following advantages:—It is far lighter in weight; it does not absorb or transmit so much heat; hence the tube is kept hotter and the room cooler than with the ordinary tiles. It does not break when dropped about; it cools rapidly, so as to be quickly handled. It may be readily cut to any shape: this is especially useful when it is necessary to keep the flame from heating the ends of the tube; in such case a hole may easily be bored in a slab, and the end of the tube passed through this, so as to shut off the access of any flame.

In using iron tubes it is a nuisance to have to constantly replace the corks used for stopping the ends. These fit well at first, but getting dry they soon cease to be gas-tight. I get rid of corks now by having the end of the iron tube polished flat,—that is, at right angles to its length,—then screw on a brass cap, having a small eduction tube. This cap is turned true internally, so that a leaden washer may be inserted between the two plane surfaces, and by the screwing up of the cap may form a gas-tight joint. Of course the heat at the ends of the tubes is never sufficient to melt lead; were it so, the amount of carbon given off by a cork in the same situation would be enough to vitiate any analysis.—I am, &c.,

A. W. STOKES, F.C.S., F.I.C.,
Public Analyst, Paddington Vestry, W.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 12, March 19, 1888.

The Absorption of Saline Matters by Plants: Potassium Sulphate.—MM. Berthelot and André.—Plants draw their mineral elements from the soil, but the mechanism of this absorption is still obscure. Substances entirely insoluble can act only by contact with the roots, an action necessarily limited to narrow surfaces, whilst most of the reactions are exerted upon dilute solutions of the soluble matters which penetrate into the roots in conformity with the general laws of endosmose, dialysis, and capillarity. Hence there arise various chemical reactions of combination and of dissociation between the matters contained in the soil and the principles dissolved in the sap of the plant. These reactions cause certain compounds to penetrate into the roots; some of them identical with those already contained in the plants, others resulting from their decomposition, whilst other compounds are excreted and diffuse themselves in the surrounding soil. Potassium sulphate accumulates by preference in the leaves. Elsewhere it is found in a smaller proportion than that which would saturate a quantity of water equal to that contained in the plant. Such saturation does not appear compatible with the vitality of the plant.

The Relations of Atmospheric Nitrogen to Vegetable Mould.—Th. Schlœsing.—The author has shown that nitrogen, like oxygen, cannot undergo the least physical condensation in the soil regarded as a porous medium. He now takes up the question whether any chemical condensation can take place, the free gaseous nitrogen passing into combination? The mineral elements of the soil, if placed in contact with gaseous nitrogen for an indefinite time, remain indifferent to it, but the organic matter is still so little known that it might be supposed capable of fixing nitrogen. The author measured the gaseous nitrogen placed in contact with the soils for a prolonged time, and ascertained the variation or the permanence of its volume. The results of these experiments will be laid before the Academy on a future occasion.

Ultra-violet Band Spectrum of the Hydrogen and Oxygen Compounds of Carbon.—H. Deslandres.—This paper cannot be usefully reproduced without the accompanying diagram.

The Laws of Chemical Equilibrium. A Reply to H. Le Chatelier.—P. Duhem.—A controversial paper, not of general interest.

On Hydrated Hydrogen Sulphide.—MM. de Forcrand and Villard.—A re-determination of the vapour-tension of this compound.

A New Oxygen-acid of Sulphur.—A. Villiers.—The author has undertaken the study of the compounds which may result from the action of sulphur dioxide upon the thiosulphates. The author has obtained anhydrous crystals of the sodium salt of an acid, S_4O_8Na, and has subsequently produced them in combination with 2 mols. of water.

Action of Certain Oxides upon Dissolved Zinc and Manganese Chlorides.—G. André.—The author has examined the behaviour of zinc chloride with yellow mercury oxide, the product being a zinc oxychloride containing only 2·6 per cent of mercury. Zinc chloride with lead oxide yields a compound of zinc oxychloride with ZnClPbO.

On Diterebenthyl.—A. Renard.—An examination of the action of heat and of bromine upon this compound.

A Contribution to the Study of the Ptomaines.—Oechsner de Coninck.—A study of the basic products formed in the bacterian fermentation of Octopi. Two novel ptomaines have been discovered, $C_8H_{11}N$ and $C_{10}H_{11}N$.

Cyanogen Compounds of the Sulphines.—G. Patein.—The author gives a table of the sulphine-cyanines obtained.

Researches on the Fixation of Nitrogen by the Soil and by Plants.—Arm. Gautier and R. Drouin.—Soils containing no organic matter lost nitrogen in each of four series of experiments. Soils containing organic matter, on the contrary, were found capable of fixing nitrogen.

Moniteur Scientifique, Quesneville. Series 4, Vol. ii., January, 1888.

On Cadmium Sulphide, and on the Different Cadmium Yellows of Commerce.—G. Büechner (*Chemiker Zeitung*).—The finest pure colours are obtained by the action of hydrogen sulphide upon solutions of cadmium salts, and whatever their shade, they consist of cadmium sulphide in different physical conditions. Such colours are absolutely stable on exposure to light, and are consequently trustworthy as oil-colours. They are permanent on exposure to air, as none of the modifications of cadmium sulphide take up oxygen at common temperatures. Rancid oils, however, containing consequently free fatty acid, may darken light shades. Impure colours containing salts of cadmium soluble in water are to be rejected. The worst are those which contain finely-divided sulphur precipitated along with the cadmium sulphide. Such colours

fade very quickly on exposure to light. Arsenic, zinc, and iron sulphides are, of course, to be rejected if they exceed a few tenths per cent. All samples should be condemned which are mixed with cadmium hydroxide, hydrocarbonate, oxalate, or phosphate, as they are always changed by exposure to light. Sulphide containing hydroxide, if ground up with oil, takes a brownish colour on exposure to light. The most frequent adulterations are the addition of zinc oxide, carbonate, or sulphide, sometimes to the extent of 50 per cent. The sample ought to dissolve in hydrochloric acid, giving off hydrogen sulphide, and yielding a transparent or faintly opalescent liquid. Carbon disulphide should extract only slight traces of free sulphur. The hydrochloric solution diluted with water and saturated with hydrogen sulphide should give a yellow or orange precipitate, and the filtrate should not become turbid on the addition of ammonia or ammonium hydrosulphate. The hydrochloric solution should not be rendered turbid by an excess of ammonia nor by calcium chloride.

Studies on the Manufacture of Santonine. — A. Busch.—From the *Journal fur Praktische Chemie*.

Identity of the Photo-salts of Silver with the Matter of the Latent Photographic Image.—Carey Lea.—Translated from the CHEMICAL NEWS.

Industrial Review and Patents. — Under this title are given papers on the "Present Condition of the Leblanc Soda Works," on the "Fixation of Chrome by Wool," on "Electrolytic Bleaching Agents," on the "Determination of Impurities in Soaps," on the "Determination of Paratoluidine in Aniline for Red," on "Aromatic Hydroxylamines," on the "Detection of Saccharine," on "Wine Yeast," and abridged specifications of the following patents:—

Process for causticising lyes of alkaline carbonates in a vacuum. H. Herbert, of Barmen, H, No. 6981.

Improvement in platinising metals by electricity. B, No. 7389.

Process for purifying and preparing metallic surfaces intended to be coated with other metals, and for renewing metallic coatings by means of the electric current. M, No. 5171.

Improvement in the preparation of calcium and potassium tartrates. Th. Gladysz. G, No. 4244.

Preparation of aluminium with double fluorides of aluminium and barium, strontium, calcium, or zinc. A. Feldmann. F., No. 3320.

Preparation of soap dried at 100°. Brandt and Fude. B, No. 7895.

Desulphuration and purification of the petroleum hydrocarbons. D. M. Kennedy. K, No. 5513.

Preparation of a dextrine free from reducing sugar and capable of being substituted for gum arabic. A. Schuhmann. No. 4634.

Preparation of strontium hydroxide from the residues of (beet-root) treacle. L, No. 4441.

Transformation of camphor and menthone into borneol and menthol. Dr. Beckmann, B, No. 7554.

Preparation of methylene chloride. F, No. 5308.

Preparation of diphenyl-pyazolon and diphenyl-methyl-pyazolon by means of benzoyl-acetic ether and phenyl-hydrazin. F, No. 3340.

Preparation of a red azo-colour by means of alkaline naphthionates. W, No. 4827.

Preparation of a blue colouring-matter. F, No. 3274.

Preparation of a new naphthylamine monosulphonic acid. Casella and Co. No. 2206.

Preparation of α-pyridyl-acrylic and α-pyridyl-acetic acids. C. F. Boehringer and Sons. B, No. 7698.

Preparation of amido-diphenyl and amido-phenylen-naphthyl-acetones. F, No. 3328.

Preparation of β-naphthylamine γ- and δ-monosulphonic acids. Kinzelberger and Co. K, No. 5732.

Preparation of the reduction-products of meta-nitraniline or nitro-toluine and colouring-matters thence derived. Poirrier and Rosentiehl. P, No. 3385.

Preparation of azo-colours derived from tetrazo-diphenyl-ortho-disulphonic acid. A, No. 1556.

Preparation of alkylic azo-colours. Bayer and Co. F, No. 3070.

Red, violet, and violet-black azo-colours. P, No. 3416.

Preparation of reduced derivatives of nitrotoluidine and nitroxylidine. Poirrier and Rosentiehl. P, No. 3433.

Preparation of sulphur-derivatives of the para-diamines and manufacture of methylene blue. B, No. 7743.

Soluble Compounds of Phosphoric Acid in Superphosphates.—H. Otto.— In a superphosphate carefully prepared there were 49·90 per cent of P_2O_5. The total quantity of P_2O_5 found in a soluble state on lixiviating this product with small repeated quantities of water was 47·20. If 20 grms. of the sample were treated with 1000 c.c. of water the soluble phosphoric acid was only 45·8 per cent.

Determination of Reductive Sugars.—R. Geduldt.—This paper does not admit of useful abstraction.

Determination of Tannins.—H. M. Rau.—From the *Journal of the American Chemical Society*.

Société de Biologie.—Session December 17, 1887.

Treatment of Obesity.—M. Leven.—A purely medical paper.

Industrial Society of Mulhouse. — Session of November 9, 1887.—A sealed paper, deposited by M. St. De Kostanecki, and subsequently opened, was read. It is to this effect:—When a chromogene becomes a colouring-matter by the introduction of two hydroxyls or of the quinone oxime group (O.NOH), the colouring-matter has the power of dyeing mordanted fibres only when the two groups in question are in the ortho-position.

M. Fourneaux sent in a memoir on alkaline discharges upon alizarin reds. Whites are got with caustic soda, blues with soda, alizarin blue, Nicholson blue, and benzazurin, yellows with caustic soda and chrysamine. All the colours are thickened with a mixture of British gum and tragacanth. After printing the pieces are steamed without pressure, passed into vitriol sours and washed.

M. Meyer read a note on the use of Indian gums as thickeners. He succeeds in using them by boiling under pressure in a steam jacketted pan. They are then preferable to gum senegal. The author finds British gum improved by boiling under pressure with the addition of 1 per cent of caustic lime.

Memoir of Gustav Kirchoff.—An address by Prof. Hofmann.

Fractionated Reduction of Ortho- and Paratoluene.—MM. Miniati, Booth and Cohen.—From *Journal of the Society of Chemical Industry*.

The Effects of Small Quantities of Bismuth upon the Ductility of Silver.—J. Scully.—From the CHEMICAL NEWS.

Bulletin de la Société Chimique de Paris.
Vol. xlviii., No. 10, November 20, 1887.

Homologues of Acetyl-acetone; General Methods for the Preparation of a Series of Diacetones, Simple Acetones, and of their Derivatives.—Alph. Combes.

New Syntheses in the Fatty Series by Means of Aluminium Chloride. — Alph. Combes. — These two papers are a continuation of those by the same author in Nos. 8 and 9.

The Action of Chlorine upon the Sulphides of the Alcohol Radicles; Preparation of Some Novel Chlorine Derivatives.—W. Spring and A. Lecrenier.—From the facts observed by the authors it follows that the hydrocarbon groups C_nH_{2n+1} behave with chlorine differently if combined with sulphur from when, combined with hydrogen, they form part of the hydrocarbons properly so-called. The latter, when treated with chlorine, yield chlorine derivatives in which the atoms of the non-metal

are distributed with less regularity. When the groups $C_nH_{2n}+1$ have been combined with sulphur the chlorine seems concentrated by preference around the atom of carbon originally united to the sulphur, invading the mol. successively, so as not to seize another atom of carbon until the affinities of the first are saturated.

The Constitution of Guthrie's Chlorised Ethyl Disulphide.—W. Spring and A. Lecrenier.—Guthrie's reaction takes place in the normal manner without any change in the position of the atoms in the molecule.

Observation on the Subject of a Memoir by Mr. W. Hallock, entitled "The Flow of Solids."—W. Spring.—The author shows that Mr. Hallock has completely misunderstood his results, and has refuted it from that point of view.

A New Method of Forming the Substituted Saffranines.—MM. Barbier and Leo Vignon.—The authors have experimented on the action of para-nitroso-dimethyl-aniline hydrochlorate upon aniline and ortho-toluidine dissolved in alcohol of 92 per cent, and in a reflux-apparatus.

The Volatile Acids of Suint.—A. Buisine.—The acids in question are the formic, acetic, propionic, butyric, valerianic, caproic, caprylic, benzoic, and phenol.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Analysis of a Mixture.—Will any of your correspondents kindly let me know where I can see a method of analysing a mixture of potassic nitrate, sodic nitrate, potassic chloride, and sodic chloride? Of course it is simple enough to estimate the bases and the nitric and hydrochloric acids (chlorine), but what I want is to find out the proportion of each substance in the mixture:—KNO_3, $NaNO_3$, KCl, and NaCl.—ALFRED LUCK.

MEETINGS FOR THE WEEK.

MONDAY, 16th.—Medical, 8.30.
—— Society of Arts, 8. "Milk Supply, and Butter and Cheese Making," by Richard Bannister, F.I.C., F.C.S.
TUESDAY, 17th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Royal Institution, 3. "John Ruskin," by Charles Waldstein. Ph.D.
—— Society of Arts, 8. "A Hundred Years' Progress in New South Wales," by W. F. Buchanan, J.P.
WEDNESDAY, 18th.—Meteorological, 7.
—— Society of Arts, 8. Telescopes for Stellar Photography," by Sir Howard Grubb, F.R.S.
THURSDAY, 19th.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.
—— Parkes Museum, 5. "The Public Health in India," by Mr. Justice Cunningham.
—— Chemical, 8 Ballot for the Election of Fellows. "The Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and of Calcium Hydroxide," by W. A. Shenstone and J. T. Cundall.
FRIDAY, 20th.—Royal Institution, 9. "Antagonism," by the Right Hon. Sir William R. Grove, M.A, D.C.L., LL.D., F.R.S.
SATURDAY, 21st.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.

TO CORRESPONDENTS.

The Institute of Chemistry.—We have received a very large number of letters on matters connected with the Institute of Chemistry, including one from Mr. W. Thomson, Royal Institution, Manchester, replying to the statements made in the letters of Mr. Friswell and "One who was There." Were we to insert all the letters sent to us on this subject, the CHEMICAL NEWS would contain nothing else for several weeks, and the majority of our readers would have just cause to complain that their interests were sacrificed for the sake of a personal controversy only interesting to a few. For this reason we must decline to allow further space to be taken up in the discussion of the Institute's affairs.—[ED. *C. N.*]

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PATENTS, DESIGNS, & TRADE MARKS ACT, 1883.

In the matter of Letters Patent granted to THOMAS GILBERT BOWICK, of Harpenden, in the County of Herts, for "An improved process and apparatus for purifying alcohols by means of hydrocarbons," dated the 29th October, 1887, No. 14737.

NOTICE IS HEREBY GIVEN that the said T. G. Bowick has applied for leave to amend the specification numbered as above.

A copy of the Specification as proposed to be amended can be inspected at the Patent Office, and full particulars of the proposed amendment were set forth in the Official Journal of the Patent Office issued on the 7th of April, 1888.

Any person intending to oppose the said application must leave particulars of his objections thereto (on Form G) at the Patent Office, 25, Southampton Buildings, London, W.C., within one calendar month from the date hereof.

Dated this 7th day of April, 1888.

(Signed) H. READER LACK,
Comptroller-General.

ABEL AND IMRAY,
Agents for the Applicant,
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Is about to start on his third trip to Mexico, the Pacific Slope, and the Rocky Mountain region. A familiarity with the Spanish language and experience in Mexican mines will render his services especially valuable to those desiring reliable information.

THE CHEMICAL NEWS.

VOL. LVII. No. 1482.

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THE INFLUENCE OF PHOSPHORUS ON THE ESTIMATION OF CHROMIUM IN IRON OR STEEL.

By J. O. ARNOLD and HENRY J. HARDY.

In the CHEMICAL NEWS (vol. xlii., p. 285) a process for the estimation of chromium in iron and steel was published by one of us. That method, although sufficiently accurate for materials low in phosphorus, is not reliable when the metalloid is abnormally high. The error arises from the fact that in such cases the final precipitate consists not of chromic oxide, but of a mixture of oxide and phosphate, or possibly of a phosphate only. The cause of such effect is that when steel or iron is dissolved in hydrochloric acid, and evaporated to dryness, a portion of its phosphorus is evolved as hydride, whilst some remains as phosphate. The question whether or not this behaviour arises from the existence of phosphorus in more than one form in the metal is not connected with the present subject.

To indicate the amount of the residual oxidised phosphorus, and its effect on the estimation of chromium, two steels and a pig-iron were made, which on analysis gave the following results :—

No.	Material.	Phosphorus, p. c.	Chromium. p. c.
1.	Steel	0·064	0·31
2.	,,	0·204	0·33
3.	Grey iron	1·080	1·18

(The phosphorus was estimated by the modification of the combined molybdate and magnesia methods published by one of us in the CHEMICAL NEWS, vol. xliii., p. 147, The chromium was determined by the process hereinafter detailed.)

Two grms. of each metal were next dissolved in 20 c.c. fuming hydrochloric acid, and evaporated to dryness. The residue was fused with a mixture of sodium carbonate and potassium nitrate, extracted with water, acidified with HCl, and made faintly alkaline with ammonia. The P_2O_5 was then estimated in the resulting precipitates. Results :—

No. 1.	Grm. P_2O_5	0·0006
2.	,, ...	0·0023
3.	,, ...	0·0202

These weights would produce the following errors on weighing the precipitate as oxide :—

No. 1.	Error ..	0·03	chromium per cent high.
2.	,, ..	0·09	,, ,,
3.	,, ..	0·74	,, ,,

In a useful little handbook on Iron and Steel Analysis written by Mr. Thomas Bayley, the author by some oversight adopts the course of dissolving the material in which the chromium is about to be estimated in *aqua regia*, thus oxidising practically the whole of the phosphorus, and then weighs the precipitate as oxide. This procedure will obviously ensure a sensible inaccuracy even in a steel low in phosphorus. Thus, taking the case of No. 1 steel. which contains 0·064 per cent of phosphorus and 0·31 per cent of chromium, the result would be registered as 0·41 per cent of chromium, or over 30 per cent high.

Again, Mr. Bayley evaporates the solution in *aqua regia* to dryness, filters off the silica, and estimates the chromium in the filtrate. This in the case of a rich chrome iron is a fatal proceeding, because with the silica will be found an insoluble metallic residue high in chromium.* Thus a chrome pig-iron containing 0·072 per cent of phosphorus and 9·83 per cent of chromium gave, by Mr. Bayley's process, only 7·38 per cent of chromium, or only 75 per cent of the metal really present.

It is therefore very necessary, in estimating high chromium in iron and steel, that the whole of the residue, as well as the products of solution, should be submitted to fusion.

Since the introduction of the Basic process, phosphoric irons and (this in a whisper) steels are more frequently dealt with by the steel analyst than formerly, and from what has been stated it will be evident that the results obtained in estimating chromium as oxide in such materials are quite untrustworthy. The authors therefore came to the conclusion that the easiest way out of the difficulty would be to obtain a definite phosphate precipitate, under which condition the presence of more or less phosphorus in the steel, or of a small quantity in the reagents used during the analysis, would become a matter of indifference.

As a preliminary step various weights of pure dry potassium bichromate were reduced in a hydrochloric acid solution by means of sulphurous acid. The chromium was then precipitated by a faint excess of ammonia in the presence of varying amounts of phosphoric acid introduced by means of a solution of sodium phosphate carefully standardised by magnesia.

The results tabulated below show that in the presence of the theoretical amount, or of a moderate excess of P_2O_5, chromic oxide is completely precipitated on digestion with a slight excess of ammonia as a basic phosphate, $Cr_6P_4O_{19}=3Cr_2O_3.2P_2O_5$, whilst in the presence of a large excess of P_2O_5 the precipitate is uncertain in composition, being sometimes the normal phosphate $Cr_2P_2O_8=Cr_2O_3.P_2O_5$, sometimes a mixture of normal and basic salt, and sometimes a mixture of normal and acid phosphate.

TABLE I.—(Grammes).

Cr_2O_3.	P_2O_5.	Precipitate.	Theory $Cr_6P_4O_{19}$.	Theory $Cr_2P_2O_8$.
0·0265	0·0221	0·0430	0·0430	—
0·0258	0·0221	0·0415	0·0418	—
0·0516	0·0387	0·0830	0·0837	—
0·0258	0·0600	0·0500	—	0·0500
*0·0546	0·0800	0·0990	0·0885	0·1056

TABLE II.

Ratio of Molecules.		Grammes.				
Cr_2O_3.	P_2O_5.	Cr_2O_3.	P_2O_5.	Precipitate.	Theory $Cr_6P_4O_{19}$.	Theory $Cr_2P_2O_8$.
3	2	0·0389	0·0240	0·0625	0·0629	—
1	1	0·0258	0·0240	0·0420	0·0417	—
†1	16	0·0258	0·3840	0·0560	0·0417	0·0500
1	32	0·0258	0·7680	0·0496	—	0·0500

Two quantities of potassium bichromate, weighing respectively 0·1000 and 0·1064 grm., were reduced by sulphurous acid in an hydrochloric acid solution, and precipitated with ammonia in the presence of excess of sodium phosphate. The indefinite phosphates thus obtained were dissolved in hydrochloric acid and re-precipitated by ammonia.

In these precipitates, after thorough washing, the phosphoric acid was determined — No. 1 by magnesia after precipitation with ammonium molybdate, No. 2 by molybdate alone. Results :—

No.	P_2O_5.	
	Theory $Cr_6P_4O_{19}$.	Found.
1.	0·0317	0·0312
2.	0·0350	0·0348

In estimation No. 1, 1·5 m.grms. was added to the

* This residue is usually practically free from phosphorus.

* Indefinite basic phosphate.
† Indefinite acid phosphate.

weight of pyrophosphate obtained as correction for solubility.

From the foregoing tables it is obvious that under suitable conditions chromium is readily obtained as a basic phosphate of invariable composition. This compound has a great advantage over the hydrate in the fact that, unlike the latter, it has little inclination to abstract silica from glass vessels; therefore the precipitation may be carried out with safety in a convenient beaker, instead of in the somewhat cumbersome porcelain basin usually deemed necessary when precipitating chromium as hydrate with ammonia.

The manipulation of the new process differs but little from that of the method published in 1880; but as the accuracy of the results depends upon a rigid adherence to detail, the exact *modus operandi* is again set forth, embodying, however, one or two alterations which extended experience has shown to be convenient.

Method.

In the case of steel about 2 grms. of drillings may be taken for analysis. (When the material under examination is a chrome pig-iron, or other rich alloy, about 0·5 grm. in *fine* powder will suffice.) The metal is dissolved in 20 c.c. of fuming hydrochloric acid,* and the solution is gently evaporated to dryness, so that the brittle cake of chlorides is readily detached from the bottom of the beaker. The mass is broken up with a spatula and brushed into a porcelain dish; the small portion adhering to the beaker is treated with 2 or 3 c.c. of hot hydrochloric acid; then by means of a "policeman" every particle of insoluble residue is detached from the glass, rinsed into a deep platinum basin, and the whole is evaporated to dryness. Whilst the evaporation is proceeding the main residue is carefully crushed to a *fine* powder in the porcelain dish, by means of a small glass pestle. The powder is added to the dry residue in the platinum basin, both dish and pestle being carefully cleaned.

The chlorides are next *intimately* mixed with not less than five times their weight of a fusion mixture composed of equal parts of dry sodium carbonate and powdered potassium nitrate; a cover is placed on the basin, and the contents of the latter are fused, cautiously at first, over a powerful Bunsen flame for at least fifteen minutes. When somewhat cool the cover is removed, and any splashings upon it are washed into a beaker containing 100 c.c. of boiling water, in which the basin containing the fusion is stirred and heated until the insoluble oxide of iron is completely detached. The dish is then carefully washed and removed.

The beaker is heated for half an hour nearly to boiling; any alkaline manganate present will be thus completely decomposed, and the oxide precipitated, the addition of alcohol as a reducing agent being quite unnecessary.

In order to save time, and to do away with the well-known difficulty of washing the finely-divided ferric oxide without causing some of it to pass into the filtrate, the authors have devised the following plan:—At the commencement of the analysis exactly 2·4 grms. of metal are weighed out, the extract and residue from the fusion are carefully transferred to a graduated flask (marked in the neck to contain 301 c.c.), diluted to the mark with warm water, and the temperature carefully noted, the homogeneity of the liquid being first ensured. When the oxides have nearly settled, about 250 c.c. are filtered off through a *dry*, *double* filter, into a ¼ litre flask marked in the neck; the liquid is again brought to its original temperature, and is then adjusted to the mark by means of a pipette: the 250 c.c. of clear liquid thus obtained contains the chromium present in 2 grms. of steel.†

The yellow chromate solution is placed in a covered beaker and acidified with about 20 c.c. of hydrochloric acid, and is then boiled. No alcohol is required to reduce the anhydride to oxide, the nitrous gas liberated from the nitrite resulting from the fusion effectually deoxidises the chromate. (The use of alcohol is very objectionable: the resulting aldehyd, &c., is not easily got rid of by boiling, and its presence tends to prevent the complete precipitation of the chromium.) At this stage excess of ordinary sodium phosphate solution must be added (say 10 c.c. of a 10 per cent solution). The phosphate is now precipitated by means of dilute ammonia, added in the smallest possible excess. The liquid is digested nearly at boiling-point till bright and colourless. The precipitate is filtered off (it need not be washed), and is then dissolved off the filter with hot hydrochloric acid into the beaker in which the precipitation took place. The filter is well washed with cold water, and is set aside under cover for use in separating the silica. The bright green solution is boiled down, and finally very cautiously evaporated to dryness. The phosphate is taken up by *boiling* with a few c.c. of hydrochloric acid, and the insoluble residue filtered off. The filter is exhaustively washed, and the filtrate, diluted to about 200 c.c., is heated nearly to boiling and treated with diluted ammonia to slight alkalinity. It is digested as before, the phosphate filtered off, *gently* washed with hot water (a too vigorous use of the wash-bottle may cause the precipitate to pass into the filtrate to some slight extent), dried, ignited, and weighed as $Cr_6P_4O_{19}$, containing 42·48 per cent of metal.

The exactness of the process, in spite of the somewhat prolonged manipulation, is indicated by the following experiments:—

Two quantities of steel, proved free from chromium, were taken: (1) 1·9646 grms., (2) 1·9965 grms. To No. 1 0·1000 grm. of potassium bichromate was added, and to No. 2 0·0100 of the bichromate. Results:—

No.	Gramme Chromium.	
	Theory.	Found.
1.	0·0354	0·0351
2.	0·0035	0·0035

As a check on the constitution $3Cr_2O_3.2P_2O_5$ the above precipitates were re-fused, extracted with water, acidified with hydrochloric acid, a little ferric chloride being also added, and the whole precipitated with a faint excess of ammonia. The resulting precipitate was dissolved in hydrochloric acid, evaporated to very low bulk, and again thrown down with excess of ammonia. Excess of strong nitric acid was next added, and whilst boiling a large excess of ammonium molybdate. The resulting yellow salt was well washed with dilute nitric acid, dissolved in ammonia, and the P_2O_5 was precipitated with magnesia mixture in the respective volumes of 30 and 15 c.c. The pyrophosphate was obtained with the usual precautions, no correction, however, being made for solubility. Results:—

No.	Gramme P_2O_5.	
	Theory.	Found.
1.	0·0319	0·0314
2.	0·0030	0·0027

By the present process the chromium in iron products can be estimated with great accuracy. It provides for the removal of all elements at all likely to be present, viz., carbon, silicon, sulphur, manganese, tungsten, and copper, whilst the elements rarely present or stated to be

* Sulphuric, nitric, and nitro-hydrochloric acids will be found in practice to be highly inconvenient solvents.

† This operation is based on the following approximate data:—An average steel is taken as containing 99·25 per cent of iron and manganese; consequently the oxide resulting from such a metal will weigh 3·4 grms.: its specific gravity has been found by experiment to be 4·13; it will therefore occupy nearly 1 c.c. Thus the total volume, 301 c.c., is the bulk occupied by the oxide plus 300 c.c. containing in solution the chromium of 2·4 grms. of steel; therefore five-sixths of this fluid will contain the chromium of 2 grms. of steel: the necessity for coincident temperatures is too obvious to require explanation. When only 0·5 grm. of material is taken, the correction for the volume of the oxide may be dispensed with without sensible error.

present in steel, viz., arsenic, titanium, and aluminium,* also do not affect the result.

It is a matter of indifference whether or not the metal is soluble or only partially soluble in the acid, though in the latter case it is advisable to prolong the fusion.

As far as the authors' knowledge goes the foregoing is the only published method applicable with propriety to every class of chrome alloys and steels.

It was suggested to them that the volumetric process sometimes applied directly to chrome metals (in which chromic salts in sulphuric acid solution are oxidised by potassium permanganate to chromates, a known quantity in excess of a ferrous salt being then added and the excess of ferrous iron determined by titrating backwards with potassium bichromate) might be applied to the precipitate of hydrate or phosphate obtained after the fusion, but experience has shown that this method is unreliable, the results being frequently low, sometimes very seriously so.

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* If this element is present it is perhaps advisable to add ammonium bicarbonate after extracting the fusion.

PRESSURE TUBES, THEIR USE, AND CONSTRUCTION.

By H. N. WARREN, Research Analyst.

THE common pressure tube, generally consisting of a piece of stout glass combustion-tubing which has been accurately sealed at either extremity, and enclosing the substance to be operated upon, is altogether too well known to need description. But in order to keep pace with scientific investigations intense pressure is often a very desirable agent to the chemist when operating on various substances, and of all substances used for the construction of the same no substance answers the purpose more admirably than that of glass, both on account of the ease with which it may be broken and its contents examined at the termination of the reaction, and the less danger of contaminating the contents with impurities than when iron, or even platinum, is used; but although even the best quality combustion-tubing, when properly sealed, will stand an intense pressure at all normal temperatures, yet, at the lowest red heat, the glass quickly begins to expand, and the tube ultimately bursts, and for the prevention of which I have used, with great success, tubes of the following construction, and intended for temperatures ranging from 400° to 700° F.

The substance for examination is first enclosed in an ordinary combustion-tube, and accurately sealed at both ends. A copper tube is next selected about two inches longer than the glass tube, and allowing of about ¼ of an inch dimension to intervene between the outside of the glass tube and the inside of the copper one. The space between the two tubes is next carefully filled in with perfectly dry magnesia, and commenced by screwing on one of the caps, with which the tube should be provided, the MgO being introduced until it protrudes slightly beyond the inside of the screw cap: the glass tube is now inserted by gently pressing, and the magnesia gradually added by small quantities at a time, until the space is entirely filled in, the tube being well tapped to ensure accurate packing of the magnesia, after each fresh addition. The tube should now, if successfully packed, be perfectly firm, and remain so on shaking. A second screw cap having been previously filled with the magnesia is next screwed over the other extremity, and the tube and its contents are introduced into a bath containing molten lead, and maintained at the desired temperature.

Excellent results may be obtained by this method, among which may be mentioned the decomposition of siliceous slags when in contact with H_2SO_4, the decomposition of fire-clay, which may be entirely decomposed in the course of an hour, and the Al_2O_3 estimated, which by any ordinary method usually takes from eight to ten hours. For higher temperatures where a red heat is desired, the outer tube should consist of wrought-iron, and fine sand substituted for the magnesia. By means of a tube constructed on this principle I have frequently maintained sulphur at a red heat for some hours, and caused a weighed quantity of the same to combine exactly with an equivalent quantity of metallic copper; I may also mention that out of a number of tubes that I have constructed by this process only two have burst; it is of course unnecessary to add that great care should be used during the reaction.

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ON THE RANGE OF MOLECULAR FORCES.*

By A. W. RÜCKER, M.A., F.R.S.

(Concluded from p. 147).

THE value of v obtained by Exner are remarkably confirmed by those deduced from the theory of Van der Waals. In the general relation between pressure, volume, and temperature, given by him, a constant b occurs which is, according to Van der Waals, $=4v$, and, according to O. Meyer, $=4\sqrt{2}v$.

The value of b may be obtained in several ways. Meyer deduces it from a comparison between the terms of Van der Waals's formula and the constants of a similar empirical formula of Regnault's. The values so obtained are of the same order as those given by other methods, but I do not think that Meyer's plan is as satisfactory as those adopted by Van der Waals hinself, as it largely depends on the value of a very small constant in the empirical formula.

Van der Waals makes two comparisons—the one with Regnault's observation (*Die Continuität*, &c., 73 to 79) and the other with Cailletet's results (*loc. cit.*, 98 and 99), and he shows that the constants obtained by the former method produce a fair agreement with the observations of Andrews (*loc. cit.*, 80).

The table is obtained by taking these results (comp. Meyer, *Kinetische Theorie*, 75) and reducing all values to the standard pressure of one atmosphere.

	Value of b from—			Value of v according to—	
	Regnault.	Cailletet.	Mean value of b.	Van der Waals, $b=4v$.	O. Meyer $b=4\sqrt{2}v$.
Air ..	0·00195	—	0·00195	0·00049	0·00035
H_2 ..	0·00049	0·00050	0·00050	0·00012	0·000088
CO_2 ..	0·0023	—	0·0023	0·00057	0·00041

The value of b for SO_2 deduced from experiments by Cagniard de la Tour is 0·0032, which leads to $v=0·0006$ according to Meyer's formula. As these early observations were probably not so accurate as the others we are discussing, I shall not make use of his results, also as Meyer's relation between b and v appears to be the best, I shall hereafter employ it only.

Before discussing this table further I must point out that there are some slight errors in the books which deal with the subject, and which account for discrepancies between the figures as given by others and by myself. The numerical value of b which is proportional to the ratio of the volume of the molecules to the volume of the gas under standard conditions, increases with the standard pressure, and may be taken as proportional to it.

The values obtained by Van der Waals from Regnault and Cailletet's results are referred to pressures of 1 m. and 760 m.m. respectively. Ruhlmann (*Mechanische Warmetheorie*, ii., 244, Vieweg und Sohn, 1885) reduces them all to a pressure of 1 metre, but in so doing he

* A Lecture delivered before the Chemical Society, Feb. 2, 1888.

multiplies the numbers which are referred to an atmosphere by 0·76 instead of dividing. Thus, as corresponding to 0·00198, he gives 0·0015, and so on. By this mistake he conceals the practical identity of the values obtained by Van der Waals.

O. Meyer himself makes a similar mistake. The value of b for CO_2 referred to a pressure of 1 m. is 0·003 (*Die Continuität*, &c., 74). Van der Waals calculates it for 1 atmosphere on p. 80, and finds $b=0·0023$. Yet Meyer (*Kinetische Theorie*, 231) treats this value as though it referred to the larger pressure, and finds that for CO_2 $d=0·18$ $\mu.\mu.$ instead of 0·23 $\mu.\mu.$, which is the correct value deduced from his other data. I point out these errors only to prevent confusion on the part of those who might happen to compare the different tables of values.

In the next table are the values of v obtained from the specific inductive capacity, the refractive index, and the theory of Van der Waals.

Table of Values of v.

	Calculated from K, as determined by—		Calculated from n, Mascart, $10^{-5}\times$	Calculated from b, Van der Waals and O. Meyer, $10^{-5}\times$
	Boltzmann, $10^{-5}\times$	v. v Klemencic, $10^{-5}\times$		
Air ..	20	20	20	35
H_2 ..	8·8	8·8	9·3	8·8
CO_2 ..	32	33	30	41

Without laying stress on the extraordinary similarity between the values of v obtained in the case of H_2 from the dynamical theory of gases, and from electrical and optical formulæ, I think that the agreement as to the order of the magnitudes of v calculated by such various methods is very strong evidence that they are approximately correct. It will also be observed that they are intermediate in value to the superior and inferior limits given by Loschmidt and Sir William Thomson respectively.

Loschmidt regarded the liquid as formed of molecules in contact, an assumption which could not give too small a value for v; Sir W. Thomson selects a condensation coefficient, which he is sure is not large enough. We thus get in the case of air—

Superior limit (Loschmidt)	86×10^{-5}
Actual value calculated from b.. ..	35×10^{-5}
,, ,, ,, n.. ..	20×10^{-5}
,, ,, ,, K.. ..	20×10^{-5}
Inferior limit (Sir W. Thomson) ..	$2·5\times10^{-5}$

We may, therefore, conclude that the space occupied in the sense previously defined by the molecules in air at 0° C. and 760 m.m. is about one five-thousanth (0·0002) of the volume of the gas. As Loschmidt's calculation is based on the assumption that in a liquid $v=1/1·17=0·85$, and as Exner's value in the above table is 20/86 of his, it follows that in liquid air the value of v would be about 0·2. Very similar values are obtained for substances which can be liquefied easily. Thus the observed value of v for water vapour is 0·00017. This is referred to 0° C. and 760. But at 0° C. and 4·6 m.m. (the maximum tension of aqueous vapour at that temperature), the volume of saturated steam is 210,660 times the volume of the liquid. Under standard conditions this would be reduced to $210,660\times4·6/760=1275$.

Hence for liquid water $v=0·00017\times1275=0·22$. We conclude that in liquids about one-fifth only of the total volume is filled with matter, which is in accord with the numbers before obtained from Hopkinson's results.

To calculate the diameter of a molecule we must know not only v but also L. This may also be determined by three independent methods of experiment, viz., by the determination of the coefficients of viscosity, diffusion, and thermal conductivity. As the values of the coefficient of viscosity given by Meyer are not reduced to 0° C., I take the values of L deduced from these given by Ruhlmann (*Mechanische Warmetheorie*, 227). For those which depend on diffusion I quote Stefan's deductions from Loschmidt's experiments as given by Exner (*loc. cit.*, 450). Taking the coefficients of thermal conductivity determined by experiment by Kundt and Warburg, Winklemann and Stefan, as given by O. Meyer (*loc. cit.* 194). I have calculated back to the coefficients of viscosity by the formula $k=1·53\eta c$, where k and η are the coefficients of conductivity and viscosity, and c is the specific heat at constant volume, and have then deduced L from the coefficient of viscosity thus calculated. The results are given in the following table, and prove that there is at a events no doubt as to the order of the magnitude of L.

Values of L.

Substance.	L in $\mu.\mu.$ calculated from— Viscosity.	Diffusion.	Thermal conductivity.
Air	99	71	110
H_2	194	139	186
CO_2	66	50	55
CO	97	65	106
N_2O	66	42	59

We are now, if the various theoretical assumptions are allowed, in a position to calculate the diameter of a molecule of air, H_2, or CO_2, by three absolutely independent methods. We may combine the values of v obtained from the specific inductive capacity, the refractive index, and the theory of Van der Waals, with the values of L deduced from the coefficients of viscosity, diffusion, and thermal conductivity, respectively. The results are shown in the following table:—

Substance.	Diameter of gaseous molecule in $\mu.\mu.$ calculated from— Specific inductive capacity and viscosity.	Refractive index and diffusion.	Expansion and thermal conductivity.
Air	0·17	0·12	0·33
H_2	0·14	0·11	0·14
CO_2	0·18	0·13	0·19

Without insisting too much on an agreement which can be exemplified in the case of a few gases only, and which would probably not be exhibited by the results of experiments on vapours, it is not too much to say that it cannot possibly be fortuitous, and that it leaves very little doubt that the so-called diameter of a gaseous molecule is of the same order of magnitude as 0 2 $\mu.\mu.$

In conclusion, I think it may be well to attempt to class the phenomena which have been observed in very thin layers of matter, and the results of calculations on the size of moleucles, in the order of the magnitudes involved. It is probable that such a statement will have to undergo much correction in the future, but it may be useful and suggestive in the present. At all events, I think it will show that the time has passed when any estimate, however rough, as to the magnitude of molecules or of the radius of molecular action is to be welcomed. We know now what the order of these magnitudes is, and observations are wanted, based on reliable methods, and leading to definite results.

In drawing up such a table I shall, therefore, reject measurements which appear to me to be open to very grave doubt.

In the first place all results as to the condensation of liquid films on solids which lead to values of the radius of molecular action of several hundred or even several thousand micromillimetres must be rejected until they are confirmed by other methods. The *onus* of proving that the bodies used are not porous, not absorbent, and not affected with impurities which can unite chemically with, or dissolve in, water, lies with the investigators who adopt this method. Not only have the observations on agate, varnished metals, and glass, shown that these are grave and probable sources of error, but Ihmori has proved that when they are as far as possible got rid of the thickness of the condensed film is very small. The fact that soap

films exhibit no trace of change in their surface-tension or other properties till a thickness of about 50 $\mu.\mu.$ is reached, makes it absolutely incredible that the radius of molecular attraction should have a magnitude of from 500 to 3000 $\mu.\mu.$ In this view I am supported by the opinion of Sir W. Thomson, who has laid it down as "quite certain that the molecular attraction does not become sensible until the distance is much less than 250 micromillimetres" (*Proc. Roy. Inst.*, xi., Part III., 415, 1887).

Important, too, as the observations of Ihmori and Warburg are, I do not think that they can be used for our present purpose. They refer only to the temporary film, and therefore do not afford direct information as to the distance between the surface of the glass and the outermost water layer. This is given by Bunsen's observations, though it is doubtful what the nature of the attraction by which the water is held may be.

I shall also reject calculations based on the polarisation produced by gases. The uncertainty as to the density of the films deprives these estimates of all value. The same objection does not, however, apply to measurements of the thickness of the electrical double layer. I shall, therefore, include these and the results of observations on the polarisation of metal by metal, subject of course, to the criticisms which I have already made. I include Plateau's results on account of their historical interest.

Tables of Properties of Thin Films and of Molecular Magnitudes.

118 $\mu.\mu.$

Superior limit to the radius of molecular action, deduced from Plateau's experiments on the pressure of a soap bubble by Maxwell's theory that the surface tension first diminishes when the thickness of the film $=\rho$.

96—45 $\mu.\mu.$

Between these limits the thickness of a film begins to be unstable, *i.e.*, the surface-tension begins to diminish. Hence the radius of molecular action must be $<$ 96 $\mu.\mu.$, and $>$ 22 $\mu.\mu.$

59 $\mu.\mu.$

Superior limit to ρ deduced by Plateau on the assumption that the surface-tension first diminishes when the thickness $=2\rho$.

50 $\mu.\mu.$

Value of ρ deduced by Quincke from experiments on capillary elevation. Hence the thickness should begin to be unstable when it is 100 $\mu.\mu.$ or 50 $\mu.\mu.$, according as we adopt Plateau's or Maxwell's views. Probably the truth lies between the two. There is therefore a remarkable accord between Quincke's result and the superior limits to the unstable thickness (96—45) obtained by Reinold and Rücker from experiment.

12 $\mu.\mu.$

Average thickness of black soap films measured by two independent methods. As the tension of a black film is equal to that of a thick film, the surface-tension, which begins to diminish at 50 $\mu.\mu.$, must increase again and reach its original value at 12 $\mu.\mu.$ The fact that each black film is of uniform thickness proves that the surface-tension is still increasing at 12 $\mu.\mu.$, which is the lower limit to the range of unstable thickness. This is also about the thickness below which, according to O. Wiener, a thin silver plate will no longer produce the same effect on the phase of reflected light as a thick silver plate would do.

10·5 $\mu.\mu.$

Thickness of the permanent water film observed by Bunsen on unwashed glass at a temperature (23° C.) at which the vapour pressure of water is small.

4 $\mu.\mu.$ to 3 $\mu.\mu.$

Average distance from centre to nearest centre of molecules in gases under standard conditions calculated by Meyer. If Exner's values of v be accepted, the distance would be more nearly 2 $\mu.\mu.$

3 $\mu.\mu.$ to 1 $\mu.\mu.$

Thickness of metal films required to polarise platinum completely according to Oberbeck.

1 $\mu.\mu.$ to 0·02 $\mu.\mu.$

Thickness of electric double layer according to Oberbeck and Falck. Lippmann found 0·3 $\mu.\mu.$

0·2 $\mu.\mu.$

Smallest thickness of silver which affects the phase of reflected light.

0·14 to 0·11 $\mu.\mu.$

Diameter of gaseous hydrogen molecule as given by combining—

(1.) The specific inductive capacity and coefficient of viscosity.

(2.) The refractive index and coefficient of diffusion.

(3.) The law of expansion and the thermal conductivity.

0·07 to 0·02 $\mu.\mu.$

Average distance between centres of molecules supposed arranged uniformly in liquids and solids according to Thomson. A superior limit found by L. Lorenz was 0·1 $\mu.\mu.$

0·02 $\mu.\mu.$

Inferior limit to the diameter of a gaseous molecule according to Thomson.

These results may be shortly summed up as follows:—

$\mu.\mu.$		
118	Superior limit to ρ	Plateau. (Maxwell).
96—45	Range of unstable thickness begins	Reinold and Rücker.
59	Superior limit to ρ	Plateau.
50	Magnitude of ρ	Quincke.
12	Range of unstable thickness ends	Reinold and Rücker.
12	Action of silver plate on phase of reflected light alters..	Wiener.
10·5	Thickness of permanent water film on glass at 23° C.	Bunsen.
4—3	Mean distance between centres of nearest molecules in gases at 760 m.m. and 0° C.	O. Meyer.
3—1	Thickness of metal films which polarise platinum	Oberbeck.
1—0·02	Thickness of electric double layer	Lippmann and Oberbeck.
0·2	Smallest appreciable thickness of silver film	Wiener.
0·14—0·11	Diameter of gaseous hydrogen molecule	Exner. O. Meyer. Van der Waals.
0·07—0·02	Mean distance between centres of nearest liquid molecules..	W. Thomson.
0·02	Inferior limit to diameter of gaseous molecule	W. Thomson.

Certain Ammoniacal Combinations of the Nickel Salts.—G. André.—Only a single nickel ammonium chloride, $NiCl,3NH_3$ is obtained by the moist way. One of the author's attempts to prepare a different compound yielded merely nickel oxychloride. Nickel ammonium sulphates are more easily obtained, the author having prepared two in addition to that formerly described by Erdmann and Laurent. There exists only a single nickel ammonium nitrate.—*Comptes Rendus*, Vol. cvi., No. 13.

A METHOD FOR THE SEPARATION AND DETERMINATION OF BORIC ACID.

By H. N. MORSE and W. M. BURTON.

THE indicator, tropæolin OO, not being sensitive to boric, carbonic, and silicic acids, or to their salts, it is practicable to liberate exactly one or all of these acids in any mixture of inorganic substances. In other words, if to a solution containing silicates, carbonates, and borates, and any other inorganic salts or hydroxides, we add tropæolin and then dilute sulphuric acid, we shall not obtain an acid reaction until all of the silicic, carbonic, and boric acids have been liberated. In the meantime, any oxides or hydroxides which were present will have been converted into sulphates, so that the mixture will finally consist of neutral salts, water, silicic, carbonic, and boric acids. If we now add to this mixture a sufficient quantity of dehydrated copper sulphate, the water will be absorbed and the silicic acid dehydrated. The mass will then consist of neutral salts, silica, and boric acid, of which only the boric acid is soluble in absolute alcohol. These facts enable us to separate boric acid with great exactness from nearly all other forms of inorganic matter. The only classes of salts known to us at present which are at all likely to interfere with such a separation are the chlorides and the compounds of iron, but both of these may be readily removed before the acids in question are liberated. The boric acid thus separated may be determined as a meta-borate of calcium, magnesium, or barium. We prefer the last form; because a mixture of carbonate and meta-borate of barium, being neither markedly hygroscopic nor capable of absorbing carbon dioxide, can be brought to a constant weight more readily than one containing the oxide of calcium or magnesium. Moreover, the use of barium enables us to employ a standard solution of hydroxide to receive the alcoholic extract of boric acid, thus saving the labour of bringing the absorbing material itself to a constant weight.

The Reagents.

1. An aqueous solution of tropæolin OO.

2. A standard solution of sulphuric acid of such strength that 1 c.c. of it is equivalent to 20 m.grms, of barium carbonate.

3. A solution of barium hydroxide approximately equivalent to the sulphuric acid. This is prepared by agitating the solid commercial hydroxide with a little cold water, filtering, and washing with cold water. The residue, thus freed from the caustic alkalies, is transferred to a flask or bottle and treated with water. From this solution the more dilute ones are prepared as they are needed.

4. Dehydrated copper sulphate prepared from the pure salt by heating in an air-bath at 150° until the whole mass assumes a uniform light colour. It is necessary to use pure copper sulphate for this purpose. The presence either of chlorides or of iron salts is not permissible, because of the solubility of cupric chloride and ferric sulphate in alcohol. It is not advisable to attempt to remove more than four of the five molecules of water of crystallisation, because of the danger of decomposing some of the salt at high temperatures. Such decomposition would result in the formation of free sulphuric acid, which would be extracted along with the boric acid by alcohol.

5. Absolute alcohol prepared by digesting for two or three days with dehydrated copper sulphate an alcohol which has previously been distilled over lime. The complete drying of the alcohol is important.

The Mode of Procedure.

If the boric acid is in solution, the liquid containing it is made slightly alkaline with caustic potassa, and evaporated on a water-bath in a porcelain dish having a width of about 100 m.m. The volume of the solution should be reduced to 10 or 12 c.c. The separation of salts during evaporation will not interfere with subsequent operations. If the material containing the boric acid is not soluble in water, a silicate for example, a solution is effected by the method recommended by one of us for the decomposition of chrome iron.* About 4 grms. of the purest solid potassium hydroxide are placed in a nickel crucible† and heated with a small flame until the fused mass becomes perfectly tranquil. The crucible is allowed to cool, and the finely ground and weighed material spread over the surface of the solidified hydroxide. The whole is then heated for two hours to a temperature just sufficient to keep the hydroxide in a fused condition. During the decomposition the mass is frequently stirred with a stout platinum wire, which is allowed to remain in the crucible. This method of bringing the acid into a soluble condition is to be preferred to fusion with the alkaline carbonates, since it yields a mass from which everything soluble can be readily extracted by water. The crucible is placed on its side in a porcelain dish, treated with hot water, and the soluble separated from the insoluble matter by filtration and washing. The filtrate is then evaporated to the small volume previously mentioned. If the material thus decomposed contains iron, the contents of the crucible must be treated with not less than 400 c.c. of water, and the dish in which the solution is made should be heated on the water-bath for a considerable time, with replacement from time to time of the evaporated water. Otherwise the separation of the iron may not be complete.

The solution of borate is treated, under proper covering to prevent loss by spattering, with a drop or two of tropæolin solution, and then with the ordinary desk solution of sulphuric acid until a distinct and permanent acid reaction is obtained. The material on the under side of the cover is washed back into the dish with the least possible amount of water, and the slight excess of sulphuric acid carefully neutralised by means of very dilute caustic potassa. The solution of boric acid, which should not exceed 20 c.c. in volume, is now thoroughly dried by slowly stirring into it the anhydrous copper sulphate, care being taken not to permit any considerable rise in temperature. The mass is afterwards pulverised with a pestle.

The extraction apparatus consists of a narrow Erlenmeyer flask having a capacity of about 150 c.c., and a straight chloride of calcium tube somewhat larger than is necessary to contain the mixture which is to be extracted. The narrow portion of the tube is plugged with cotton-wool. To its lower end is attached, by means of rubber tubing, a small glass tube which reaches to the bottom of the flask when the stopper carrying the extraction tube is in position. The quantity of the dilute barium hydroxide solution which is equivalent to 25 c.c. of the standard sulphuric acid is run into the flask, and the apparatus attached to the filter-pump. This quantity of the hydroxide would weigh, if converted into carbonate, just 500 m.grms. During the filling of the extraction tube with the copper sulphate mixture, the outside is occasionally tapped to render the material more compact.

The porcelain dish is washed with several small portions of absolute alcohol, which are then poured into the tube. When the whole of the copper sulphate has become wet with the alcohol the pump is shut off, and the mass allowed to soak for fifteen minutes. Afterwards five other portions of absolute alcohol, of 15 c.c. each, are poured into and slowly drawn through the tube, care being taken to allow each portion to filter through completely before another is added.

Finally, the excess of the barium hydroxide is precipitated by passing into it a current of carbon dioxide; the contents of the flask are transferred to a weighed platinum dish, evaporated to dryness, and heated to constant weight over a triple burner.

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* *American Chemical Journal*, iii., 163.

† A silver crucible is not to be recommended, because of the solubility of silver in potassium hydroxide.

The quantity of boric anhydride is found by the following proportion :—

Mol. weight of B_2O_3—mol. weight of CO_2 : mol. weight of B_2O_3 : : weight found—theoretical weight of the barium as carbonate : weight of B_2O_3 found.

If the atomic weights of Clarke have been used throughout, the difference between the weight found and the calculated weight of the carbonate (500 m.grms.) is to be multiplied by the number 2·697012; if those of Meyer and Seubert have been employed, this difference is to be multiplied by the number 2·701822.

The accuracy of the method was tested by determining the boric acid in pure borax glass (prepared by ourselves), in datholite from Bergen Hill, and in tourmaline from Pierrepont, N.Y.

We give the results below :—

I. *Borax Glass.*

Measured portions of a standard solution were employed.

Theoretical percentage of B_2O_3, 34·61. Found, 34·64, 34·58, 34·64, 34·57, 34·57.

Five determinations made by Mr. R. L. Henderson of this Laboratory (Chemical Laboratory, Johns Hopkins University) gave the following percentages of B_2O_3 in our borax glass :—34·60, 34·60, 34·59, 34·58, 34·59.

II. *Datholite from Bergen Hill.*

Theoretical percentage of B_2O_3, 21·82. Found, 21·75, 21·68, 21·62, 21·65, 21·64. Mean, 21·67.

III. *Tourmaline from Pierrepont.*

This mineral was recently carefully analysed by Dr. Riggs.*

Five determinations of the boric acid were made by ourselves, one by Mr. C. C. Blackshear, and one by Mr. Henderson.

Percentage of B_2O_3 found by Dr. Riggs, 10·15, 10·00, 10·31; by ourselves, 10·03, 10 08, 10·11, 10·03, 10·13, Mean, 10.08. Found by Mr. Blackshear, 10·02; by Mr. Henderson, 10·12.—*American Chemical Journal*, Vol. x., No. 2.

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 14th, 1888.

SHELFORD BIDWELL, F.R.S., Vice-President, in the Chair.

MR. W. E. SUMPNER, B.Sc., read a paper on "*The Variation of the Coefficients of Induction.*"

The author pointed out that there are three ways of defining the coefficient of self-induction of a circuit, expressed by the following equations :—

$$(1)\ e = L_1 \frac{dc}{dt}. \qquad (2)\ N = L_2 C.$$

$$(3)\ T = \tfrac{1}{2} L_3 C^2.$$

Where e = back E.M.F. due to change of current, C = current, N = total induction through the circuit, and T the kinetic energy of the circuit.

If the medium be air, L_1, L_2, and L_3 are identical, but in the case of iron this is no longer so.

When the curve of magnetisation is given, their values corresponding with any value of C can be easily determined by the above equations.

Maxwell's absolute method of measuring self-induction gives L_2; and by a modification due to Prof. Ayrton, where the current is altered from C_1 to C_2 instead of from o to $C = \frac{C_1 + C_2}{2}$, the value of L obtained is approximately L_1, if $C_1 - C_2$ is small compared with C.

From the known character of the curves of magnetisation of iron, it is easily seen that the value of L_2 increases with the current when the current is small, then becomes nearly constant, and afterwards decreases. For an electromagnet having a horseshoe core of best Swedish iron, ½" diameter and 14" long, wound with 800 convolutions, the value of L_2 for currents between 0·047 and 0·107 amp. was found to satisfy the equation—

$$L_2 = \frac{A}{5} + 0{\cdot}0425,$$

where A = current in ampères.

A method of comparing self-induction with capacity is described in which the arms of a Wheatstone bridge, opposite the one containing self-induction, is shunted by a condenser of capacity, K. The bridge is balanced for steady currents, and the deflection, θ_1, of the galvanometer observed on breaking the battery circuit.

θ_1 is : : $L_2 - K p s$, where p and s are the resistances of the two remaining arms of the bridge. The condenser is then disconnected, and another swing, θ_2, obtained on again breaking the battery circuit.

$$\theta_2 \text{ is } :: L_2 \therefore \frac{\theta_2}{\theta_1} = \frac{L_2}{L_2 - K p s},$$

Or—

$$L_2 = \frac{\theta_2}{\theta_2 - \theta_1} . K p s.$$

Further experiments were made on the electro-magnet when its poles were joined by a piece of soft iron, the currents being reversed. The resulting values of L_2, $\mathfrak{B}$, $\mathfrak{H}$, and μ are given in absolute measure, and from them the author deduces—

$L_2 = 0{\cdot}05 + 3{\cdot}9\,A$, $\mu = 210 + 720\,\mathfrak{H}$, $\mathfrak{B} = 210\,\mathfrak{H} + 720\,\mathfrak{H}^2$,

for values of A between 0·06 and 0·9. The difficulties experienced in determining the induction coefficient for strong magnetising forces produced by the testing current are described. They arise chiefly from the fact that in order to obtain strong currents the resistances must be small. This makes the "*time constant*" large, and in order to obtain the values of L in absolute measure a ballistic galvanometer of very long period would be required. A method of calibrating a galvanometer of comparatively short period, to give approximate results, is described.

Where the magnetising force is produced by an independent coil no such difficulties present themselves. Results obtained for the coefficients of self-induction of a gramme armature (A type), for different currents round the field's magnets, vary from 0·0218 for current 0 to 0·0117 for a current of 29 ampères.

The value of L for a given point on the curve of magnetisation is not a definite quantity, but has always two or more distinct values, depending on whether the magnetisation is increased or decreased by the test current and on the previous history of the iron. That this must be the case is easily seen from the curves obtained by Prof. Ewing in his "Experimental Researches on Magnetism." The values of L, corresponding to the three sides of a small Ewing cycle, are denoted by L_p ("*progressive coefficient*"), L_r ("*return coefficient*"), and L_c ("*cyclic coefficient*"). L_p is always the largest, whether the magnetisation be increased or decreased by the testing current. Numerical values of L_p and L_c obtained from a Kapp and Snell transformer are given. L_c can be very accurately determined by Profs. Ayrton and Perry's secohmmeter, and some of the results given in the paper were thus obtained.

Having given the curve of magnetisation,, and that connecting impressed E.M.F. and time, a simple graphical method is described for drawing the current curve.

* *American Journal of Science*, xxxv., 45.

Applying this to an alternating current where the E.M.F. is a pure sine junction of the time, it is shown that the resulting current curve differs considerably from a sine curve. The case of the rise of current in the magnet coils of a dynamo excited by accumulators is also discussed, the desired curves being in accordance with observation.

In conclusion, the author pointed out that the time taken to discharge a condenser through a given resistance may be decreased by adding self-induction to the circuit, provided L is less than $\frac{1}{2} K R^2$. When $L = \frac{1}{4} K R^2$ the discharge is completed in one-half the time required when $L = o$. This may account for the remarkable results observed by Dr. Lodge in his experiments on iron and copper as lightning conductors.

Mr. C. V. Boys described and performed "*Some Experiments on Soap-Bubbles*," and by their aid demonstrated in a remarkable manner the phenomena of surface tension, diffusion, and the magnetic properties of gases. By blowing one bubble inside another he showed that there is no electrical force inside a closed conductor. A peculiar property of soap-bubbles is their refusal to come into contact when knocked against each other; they may receive violent shocks, and still remain separate. If, however, an electrified body be brought in the vicinity, they immediately coalesce. So sensitive are they to electrical attraction that a potential difference due to one Léclanche cell between the two bubbles causes them to unite. They may thus serve as very delicate electroscopes.

Many other beautiful and extremely interesting experiments, on liquid films of different shapes, were performed in a masterly manner.

CORRESPONDENCE.

THE USE OF THE TERMS "ANALYSIS" AND "ASSAY."

To the Editor of the Chemical News.

Sir,—Permit us to reply to Mr. Allen's letter in the Chemical News (vol. lvii., p. 140). He favours us with three definitions of "Analysis," of which we can only admit the first, whilst even this is incomplete, and also betrays his lurking sense of the inaccuracy of the second and third, in that he terms the first "*a*. A true analysis, or separation of a substance into its constituent parts," which "true analysis" he justly witholds from his later definitions. Mr. Allen does not attempt a definition of the term "Assay," occupying three paragraphs of your Journal in describing his own meaning of it.

With your permission we would rest our contention of the strict and definite meanings of analysis and assay, not on our own notions, but on the definitions of a master in the art, the late Richard Phillips, F.R.S., of the Royal School of Mines, and formerly a President of the Chemical Society, to be found in "The Penny Cyclopedia of the Society for the Diffusion of Useful Knowledge," 1833.

"Chemical analysis is the separation of compound bodies either into their simpler or their elementary constituents," and

"'Assay,' or rather 'assaying,' a chemical operation which differs from analysis only in degree. Where an analysis is performed the nature and properties of all the ingredients of a substance are determined; but in assaying the quantity of any particular metal only which the ore or mixture under examination may contain is ascertained, without reference to the substances with which it is mixed or alloyed."

We would venture to add to the above that in this article "Assaying" is confined to metals and their ores, and the processes to "furnacing," as we have somewhat rudely termed it. It does not contain even the most remote hint that the term "assaying" can be further extended, which compels us to the explicit denial of Mr. Allen's question, "Cannot we have an 'assay' of sulphur ore, bleaching-powder, or alkali, unless the operation is conducted in a furnace." In confirmation of the foregoing we may say that Berthier, in his exhaustive "Traité des Essais par la Voie sèche," never contemplates the extension of "essai" beyond its application to metals and their ores.

In his protest against our statement that he used the phrase "Assay of Morphia," Mr. Allen is fully justified, and we would beg of him to accept our apology for having made it. How this error arose does not matter; we ought to have detected and corrected it in the proof, but not having done so the blunder is fairly fastened on us. Probably we meant Assay of Opium. Be this as it may, we at once accept Mr. Allen's assurance that he "cannot find in his writings the expression 'Assay of Morphia.'" May we add that we hope he will yet avoid the use of "assay" in connection either with opium or with morphia. —We are, &c.,

E. F. Teschemacher and J. Denham Smith.

Highbury, April 11, 1888.

TITRATION OF MORPHIA.

To the Editor of the Chemical News.

Sir,—I should feel much obliged to Messrs. Teschemacher and Smith if they will kindly describe somewhat more in detail the method of titrating the crude morphia obtained by their method. I have found considerable difficulty in obtaining anything approaching to a sharp end reaction with litmus. And this difficuly must be considerable when "colouring and other organic matters" are present to the extent of ten per cent.—I am, &c.,

Carter Napier Draper.

Dublin, April 12, 1888.

HOW IS IT DONE?

To the Editor of the Chemical News.

Sir.—The following is the reply which I received in response to a request for more precise information regarding some analytical work offered to me.

"We would require about 36 samples weekly to be analysed for total solids, and butter-fat, &c., merely. They would arrive on certain fixed days which could be arranged to suit your convenience. What we paid here was £20 for the whole season, ranging from April till November. As the season advances the number of samples would gradually lessen. The sum mentioned would be for the whole season. We shall be happy to hear from you at your earliest convenience if you can undertake this duty. If the remuneration would not be satisfactory, you could state an average price per sample with a minimum limit."

If my calculations are correct the remuneration here specified is less than 4d. per sample? Can any of the readers of the Chemical News tell me how to make milk analyses pay at this rate?

Mr. Walter Besant talks eloquently of the "Law of 11½d."; does he know anything of the Law of 3¾d.?—I am, &c.,

Thomas Farrington, M.A., F.C.S., F.I.C.,
Analyst to the County Cork Agricultural Society.

Analytical Laboratory, 4, Waterloo Place,
Cork, April 17th, 1888.

Action of Bromine upon the Compounds of Aldehyds and Glycol.—H. Lochert.—The result of the reaction of bromine with ethylic aldehyd is a solid mass consisting of crystalline laminæ. Very little bromine escapes.—*Bull. de la Soc. Chim. de Paris*, Vol. xvi., No. 11.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 13, March 26, 1888.

The Relations of Atmospheric Nitrogen with Vegetable Mould.—Th. Schlœsing.—The disappearance of oxygen shows that the combustion of organic matters has taken place in the samples of soil in different degrees, depending on the quantities and the nature of these matters. During this combustion nitric acid has been formed and ammonia has disappeared. The volumes of gaseous nitrogen contained in the atmospheres of the samples have not varied sensibly; the very trifling variations observed, in excess or in deficiency, do not exceed the limits of errors committed in measuring and analysing gases.

The Absorption of Saline Matters by Vegetables: Potassium Acetate and Nitrate.—MM. Berthelot and André.—The presence of a considerable proportion of potassa in the soil in a form easy of absorption does not exert a marked influence on the fixation of this alkali by plants. Potassium nitrate exists in the tissues of most plants in such a proportion that it must be formed in the tissues.

The Formation of the Hydrates of Gases.—MM. de Forcrand and Villard.—At the moment when a gas forms a crystalline hydrate with water it is not simply a saturated solution which solidifies, but a considerable excess of the gas disappears and combines with the water of the solution to form a solid compound.

The Use of Thompson's Calorimeter to Determine the Practical Heating-power of Coal.—M. Scheurer-Kestner.—It results from the author's experiments that if the Thompson calorimeter can supply practical men with sufficient indications when only an approximate result is required, it is not worthy of unlimited confidence.

The Fixation of Nitrogen by the Soil and by Plants.—Arm. Gautier and R. Drouin.—A former series of experiments had shown that the soil, if it contains organic matter, can fix nitrogen independently of vegetation. The second series shows that vegetation constitutes an additional method of fixing nitrogen.

Certain Derivatives of Ortho-aldehydo-phthalic Acid.—S. Raeine.—This paper is not adapted for useful abstraction.

Bulletin de la Société Chimique de Paris. Vol. xlviii., No. 11, December 5, 1887.

Researches on the Emission of Ammonia by Vegetable Mould.—MM. Berthelot and André.

Researches on Drainage.—M. Berthelot.

The Direct Fixation of the Gaseous Nitrogen of the Atmosphere by Vegetable Soils.—M. Berthelot.

Direct Fixation of the Gaseous Nitrogen of the Atmosphere by Vegetable Soils in Presence of Plants.—M. Berthelot.

The Various States of Tellurium.—MM. Berthelot and Fabre.

Formation-heat of Hydro-telluric Acid.—MM. Berthelot and Fabre.

Graduation of Tubes for Gasometric Measurements.—M. Berthelot.

The Calorimetric Bomb and the Measurement of Combustion-heats.—MM. Berthelot and Recoura.

Combustion-heats.—MM. Berthelot and Louguinine.

The Transit from the Aromatic to the Fatty Series.—MM. Berthelot and Recoura.—All the above memoirs have appeared in substance elsewhere and have been already noticed.

The Caprylidene of Caprylene; its Isomerism with the Caprylidene of Caprylic Aldehyd.—A. Béhal.—The caprylidene of caprylene is a substituted acetylenic carbide, since it does not react with cuprous chloride or ammoniacal silver nitrate. This carbide is methyl-amyl-acetylene, an isomer of the caprylidine of caprylic aldehyd.

Some Chloro-derivatives of Acetic Ether.—M. Maurice Delacre.—Of the 48 theoretically possible derivatives formed by chlorine in successively displacing the eight atoms of hydrogen in acetic ether, the authors have prepared and examined mono-chloro-ethyl-acetate, mono-chloro-ethyl-mono-chloracetate, mono-chloro-ethyl-bichloracetate, mono-chloro-ethyl-trichloracetate, bichloro-ethyl-acetate, bichloro-ethyl-mono-chloracetate; bichloro-ethyl-bichloracetate, bichloro-ethyl-trichloracetate, trichloro-ethyl-acetate, trichloro-ethyl-mono-chloracetate, trichloro-ethyl-dichloracetate, and trichloro-ethyl-trichloracetate.

Compounds of Aldehyds and Glycol.—H. Lochert.—The author describes the isobutylic and propionic aldehyds.

Certain Derivatives of Saccharic and Mucic Acid.—M. Maquenne.—It is known that the neutral ethers of saccharic and mucic acid yields with acetyl chloride isomeric tetracetylic derivatives. The author has endeavoured to prepare the corresponding acids by means of zinc chloride, and finds that under these conditions saccharic and mucic acid do not yield the same derivatives.

No. 12, December 20, 1887.

New Method of Forming Safranines.—MM. Ph. Barbier and Leo Vignon.—The authors have shown that phenosafranine and its homologues may be prepared by the reaction of the paramido-azo-derivatives, such as amido-azo-benzol and amido-azo-toluol upon the mono-nitro mono-benzenic carbides in presence of reducing agents.

MEETINGS FOR THE WEEK.

MONDAY, 23rd.—Medical, 8.30.
—— Society of Arts, 8. "Milk Supply, and Butter and Cheese Making," by Richard Bannister, F.I.C., F.C.S.
—— Society of Chemical Industry, 8. "Notes on the Manufacture of Chlorine," by Mr. Kingzett. "Further Notes on Electrolytic Bleaching—Hermite's process," by Messrs. Cross and Bevan.

TUESDAY, 24th.—Institution of Civil Engineers, 8.
—— Royal Medical and Chirurgical, 8.30.
—— Royal Institution, 3. "John Ruskin," by Charles Waldstein. Ph.D.
—— Society of Arts, 8. "Craftsman and Manufacturer,' by Lewis Foreman Day.

WEDNESDAY, 25th.—Geological, 8.
—— Society of Arts, 8. "The Physical Culture of Women," by Miss Chreiman.

THURSDAY, 26th.—Royal, 4.30.
—— Telegraph Engineers, 8.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.

FRIDAY, 27th.—Quekett Club, 8.
—— Royal Institution, 9. "Electrical Influence Machines," by James Wimshurst.

SATURDAY, 28th.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.
—— Physical, 3. "On Electromotive Force by Contact," by C. V. Burton. "On a Theory Concerning the Sudden Loss of Magnetic Properties of Iron and Nickel," by H. Tomlinson. "Note on the Graphic Treatment of the Lamont Frölich Formula for Induced Magnetism," "Note on the Conditions of Self-excitement in a Dynamo Machine," and "Note on the Conditions of Self-regulation in a Constant Potential Dynamo Machine," by Prof. S. P. Thompson.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Boracic Acid.—Can any one favour with a description of an accurate quantitative method for determination of boracic acid in minute proportions; in meat, for instance?—W. K. Y.

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By Order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
April 13th, 1888.

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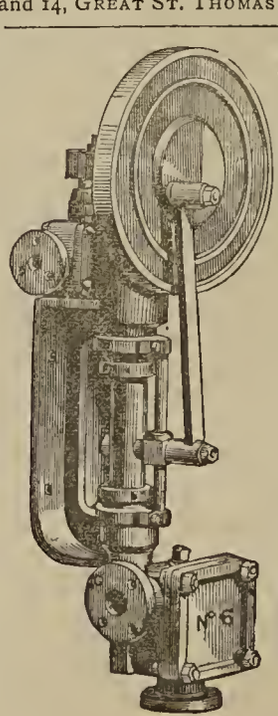

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THE CHEMICAL NEWS.

Vol. LVII. No. 1483.

ON THE LOGARITHMIC LAW OF ATOMIC WEIGHTS.*

By G. JOHNSTONE STONEY, M.A., D.Sc., F.R.S.

This memoir is divided into five sections.

Section 1.—When Newlands pointed out the dependence of the atomicity and other properties of some of the chemical elements upon the order in which their atomic weights succeed one another, and especially when this law was extended by Mendeleeff to all the elements, it became manifest that there exists a mathematical relation between a series of numbers and the successive atomic weights of the elements.

In the first section the reason is pointed out why the search for this law has been fruitless, at least as hitherto pursued by the author. The method he adopted was to plot down the atomic weights as ordinates of a diagram of which the abscissæ represented some simple numerical series, and to endeavour to extract information from the resulting curves. In this method atomic weights are represented by lines, the ordinates of the figure. Now in the next section it will appear that, in that case, the curve is represented by the equation—

$$y = k\ (\log x)^{\frac{1}{3}},$$

and is further complicated by x not representing simple integer numbers, but a circular function of them. The search, therefore, by this method was from the first hopeless, as the resulting curve is one which has not been studied by geometers, and of which accordingly the inquirer could not recognise the appearance when presented to him.

In Section 2 another method is pursued. The successive atomic weights, instead of being represented by lines, are represented by volumes. A succession of spheres are taken whose volumes are proportional to the atomic weights, and which may be called *the atomic spheres*. When the radii of these spheres are plotted down on a diagram as ordinates and a series of integers as abscissæ, the general form of the logarithmic curve—

$$y = k \log (qx)$$

becomes apparent: and close scrutiny has shown that it expresses the real law of nature. It is the central curve that threads its way through the positions given by observation, and the deviations from it of the positions assigned by the actual atomic weights will be included by making x a circular function of integer numbers, instead of those numbers themselves. The first three terms of this function have been determined.

The issue of the investigation is to show that when such a diagram is formed with ordinates which are the cube roots of the atomic weights referred to hydrogen as unit, so that the ordinates may be the radii of spheres whose volumes represent the atomic weights—

1. The logarithmic curve—

$$y_m = k\ .\ \log (m\alpha),$$

(where $\log k = 0{\cdot}785$

and $\log \alpha = \bar{1}{\cdot}986$)

threads its way through the positions plotted down from the observations.

2. In the case of the perissads (the elements of uneven atomicity) the complete curve which includes their perturbations from the central curve is—

$$y_m = k \log \left[\alpha\left(m + \tfrac{1}{3}\sin\frac{m\pi}{27} + \tfrac{1}{3}\sin\frac{m\pi}{18} + \text{subsequent terms}\right)\right]$$

the next being probably either—

$$-\tfrac{1}{2}\sin\frac{m\pi}{9}, \qquad \text{or} \qquad -\tfrac{2}{3}\sin\frac{m\pi}{9}$$

3. The form of the function representing the perturbations of the artiads is different, at all events after the third term.

Section 3.—There are other neighbouring logarithmic curves which pursue a course close to the observed positions, and in Section 3 the method adopted in dealing with these curves is described, and the grounds on which they have been successively excluded are stated. The evidence relied on has been, for the most part, that the perturbations from them are less reducible to order.

In Section 4 the curve finally selected is thrown into a polar form, and furnishes a diagram of singular convenience for laboratory use. It presents conspicuously the informa- which a Newlands and Mendeleeff's table is capable of supplying, with the further advantage of also placing before the eye an intelligible representation of the atomic weights.

The last section contains some observations suggested by the investigation.

* Abstract of a Paper read before the Royal Society, April 19th, 1888.

ON THE COMPOUNDS OF AMMONIA WITH SELENIUM DIOXIDE.*

By Sir CHARLES A. CAMERON, V.P.I.C., F.R.C.S.I., and JOHN MACALLAN, F.I.C.

The following experiments were undertaken with the object of determining the action of ammonia upon selenium dioxide. They have resulted in the discovery of two new compounds, which, from what has been ascertained regarding their constitution, may perhaps be best designated by the term *selenosamates:* they are ammonium compounds of an acid (yet to be isolated) which we name *selenomosic.*

Preparation of Neutral Ammonium Selenosamate.

Ammonia, which had been carefully dried by passing through a series of potash tubes, was led into a solution of selenium dioxide in absolute alcohol. After being absorbed for some time, minute crystals commenced to deposit, and when complete precipitation had taken place the liquid portion was filtered off, the crystals washed with alcohol, and dried over sulphuric acid in a vacuum.

The compound thus formed was found to be a deliquescent salt, which separates from its solution in alcoholic ammonia in minute, but very well-defined, hexagonal prisms and pyramids, both forms often occurring in combination. It is a very unstable substance, continuously liberating ammonia, and tending to the formation of a more stable acid salt. Some of the crystals which had been placed in a large stoppered bottle were found after some weeks to be entirely converted into large crystals of the acid salt. It also loses ammonia when treated with alcohol or water; and when its aqueous solution is evaporated in a vacuum, crystals of the acid salt remain. When heated, it is at once converted into the acid salt. On account of its instability it is best prepared in a partial vacuum, and when dried placed in a stoppered bottle, which should be quite full and kept in a cool place. In this way it may be preserved of definite composition for a considerable time. It is with difficulty, and but partially,

* A Paper read before the Royal Society, April 19th, 1888.

converted into ammonium selenite by the action of water upon it. When barium chloride is added to its neutral aqueous solution, only a faint cloudiness is produced, until it is heated, when a slight precipitate forms, but, even after standing for weeks and long-continued boiling, only a portion of the selenium precipitates. Addition of excess of ammonia to the solution, however, precipitates a basic barium salt. It is but sparingly soluble in cold alcoholic ammonia. 1·6658 grms. of solution. from which crystals had deposited left a residue of 0·0134 grm., reduced to acid salt, which is equivalent to a solubility of one part in 116 at 12°. Heated with the alcoholic ammonia it dissolves freely, but on cooling the solution remains long supersaturated, crystals continuing to deposit for several days. It is very slightly volatile at ordinary temperatures, both in a vacuum and in a current of air. As might be expected, potash at once liberates ammonia from it. Sulphurous acid and stannous chloride reduce it with separation of selenium. It is only slightly affected by hydrochloric or nitric acid in the cold, but strong sulphuric acid reacts violently upon it, a portion of the salt being sublimed by the heat evolved. Chlorine passed through its aqueous solution converts it completely into ammonium selenate, a reaction which was taken advantage of for its analysis. 0·7820 grm. was dissolved in water, saturated with chlorine, and barium chloride added. The resulting barium selenate weighed 1·5150 grms., equivalent to a percentage of 76·84 of selenium dioxide. The ammonia was estimated by Kjeldahl's process, slightly modified on account of the volatility of the substance. 0·5651 grm. was mixed roughly with potassium permanganate in a small strong flask by means of a glass rod, after which a thin tube containing 10 c.c. of sulphuric acid mixture was lowered into it, and broken by shaking the flask after it had been well secured with an india-rubber cork. It was then heated to 150° for one hour in a paraffin bath. The contents of the flask distilled with potash yielded 0·13175 grm. of ammonia, equivalent to a percentage of 23·32. The results obtained agree with the composition $2NH_3,SeO_2=NH_4,SeO_2NH_2$.

	Calculated.	Found.
SeO_2	76·53	76·84
NH_3	23·47	23·32
	100·00	100·16

The original alcoholic solution from which the crystals had deposited was found to contain selenium. In order to ascertain in what form it existed a portion of the solution was evaporated to dryness in a vacuum The residue weighing 0·666 grm., treated as before, yielded 1·285 grms. of barium selenate, equivalent to 76·53 per cent of selenium dioxide, the theoretical amount in the above compound showing that a portion remained in solution after the crystals had deposited. It was considered a matter of interest to ascertain how much of the nitrogen in this salt would be precipitated by platinum chloride. 0·5772 grm. was accordingly taken, platinum chloride poured upon it, alcohol added, and the mixture allowed to stand in the cold. The double chloride obtained weighed 1·5502 grm., equivalent to a percentage of 20·59 of ammonia. A second estimation, in which 0·4153 grm. was taken, yielded 1·1206 grms. of the double chloride, equivalent to 20·69 per cent of ammonia. In a third estimation 0·3835 grm. was evaporated down with platinum chloride, but the double chloride obtained, 1·0237 grm., showed a rather smaller percentage of ammonia, namely, 20·52. The mean of the first two results, 20·64, is equal to 87·94 per cent of the total ammonia, and indicates that, in addition to the basic nitrogen, about three-fourths of the nitrogen contained in the radical of the salt is precipitated by platinum chloride.

Preparation of Acid Ammonium Selenosamate.

A solution of the neutral salt in absolute alcohol was boiled down on the water-bath until crystals were deposited. The liquid portion was then drained off, and the crystals washed with alcohol, and dried in a vacuum. On examination they proved to consist of an acid salt. It was also found that exposure of the neutral salt in a vacuum over sulphuric acid for thirty hours was sufficient to convert it into the same acid compound. A portion of the salt obtained in the latter way was submitted to analysis. For estimation of the selenium 0·2 grm. was dissolved in water, saturated with chlorine, and precipitated with barium chloride. The resulting barium selenate weighed 0·409 grm., equivalent to a percentage of 81·11 of selenium dioxide. In a second estimation 0·4268 grm. yielded 0·8761 grm. of barium selenate, equivalent to 81·42 per cent of selenium dioxide. Kjeldahl's process was found to be unsuitable in this case for estimating the ammonia, the amount yielded by it being much too low, although a very high temperature was maintained for a considerable time. Combustion with soda-lime also gave insufficient results, owing to a portion of the substance being decomposed by the heat employed, with evolution of nitrogen. Somewhat better results were obtained by Dumas's process: 0·4035 grm. yielded 49·9 c.c. of nitrogen at 12° and 771·6 m.m., equivalent to a percentage of 18·09 of ammonia. An estimation of the selenium in the dried crystals was also made: 0·1523 grm. yielded 0·3134 grm. of barium selenate, equivalent to 81·62 per cent of selenium dioxide. The results thus obtained agree with the formula—

$$2SeO_2,3NH_3=NH_4,H,(SeO_2NH_2)_2.$$

	Prepared in vacuum.		Crystallised from alcohol.	Calculated.
	1.	2.	3.	4.
SeO_2 ..	81·42	81·11	81·62	81·30
NH_3 ..	18·09	—	—	18·70

The salt thus obtained is deliquescent, and easily soluble in alcohol, from which it separates in large prisms. 2·0270 grms of saturated solution left a residue weighing 0·1191 grm., showing a solubility of one part in sixteen of absolute alcohol at 14°. No hydrate was obtained by evaporating its aqueous solution, but the same crystalline forms were deposited as from alcohol. With barium chloride it behaves similarly to the neutral salt, a partial precipitation taking place only with difficulty. It possesses much greater stability than the neutral salt, but like the latter it is reduced by sulphurous acid and stannous chloride, and oxidised by chlorine. Potash decomposes it with evolution of ammonia, but hydrochloric, nitric, or sulphuric acid has only a slight action upon it in the cold. Kept in a vacuum or in a current of air, it is appreciably volatile at ordinary temperatures. When heated strongly a portion of it sublimes unchanged, part of it is converted into ammonium selenite, while the remainder is decomposed into ammonia, water, nitrogen, and a residue of fused selenium. In order to estimate the amount of ammonia precipitated by platinum chloride, 0·3140 grm. was taken, which yielded 0·6234 grm. of the double chloride, equivalent to 15·26 per cent of ammonia, the amount thus precipitated being equal to 81·60 per cent of the total amount of ammonia in the salt.

Relation of the Selenosamates to Sulphur Compounds.

It is stated that a compound is formed by the action of ammonia on sulphur dioxide, but the description of its properties shows that it does not correspond with the selenosamates. The latter bodies correspond more closely with the compounds which sulphur trioxide forms with ammonia. The molecule SeO_2, therefore, in these reactions acts similarly to SO_3, rather than to what is usually regarded as its sulphur analogue, namely, SO_2.

In conclusion, we are engaged at present in the production of other selenosamates, and hope to give an account of them at an early date.

Public Analyst for Islington.—The Vestry of St. Mary, Islington, on Friday, April 20th, elected Frank L. Teed, D.Sc., F.C.S., F.I.C., Public Analyst for the Parish.

ON THE

DETECTION AND ESTIMATION OF MAGENTA IN ORCHIL AND CUDBEAR.

By CHRISTOPHER RAWSON, F.I.C., F.C.S.

VARIOUS methods have been proposed from time to time for detecting the presence of magenta in orchil and cudbear. But on account of the difficulty hitherto experienced in completely separating orsein from salts of rosaniline, there are few, if any, published methods which are sufficiently delicate to detect very minute quantities of magenta in these colouring-matters. H. Crossley* precipitates the magenta by ammonia, and E. Knecht† makes use of caustic soda for the same purpose, but since rosaniline is appreciably soluble in alkalies, a small quantity of magenta would be entirely overlooked by the employment of either of these methods. Liebmann and Studer‡ saturate a solution of the orchil or cudbear with sulphurous anhydride, and, after filtering, add either acetone or aldehyd, when, if magenta be present, the colour of the liquid changes from red to violet. They state that by this reaction $\frac{1}{20}$ per cent of magenta in cudbear can be detected. In making use of this process, on account of the cudbear which remained in solution after saturating the liquid with sulphurous anhydride, I have been unable to detect such a small quantity.

The method which I have to propose is based upon the complete precipitation of the colouring-matter of orchil and cudbear in an aqueous and alcoholic solution by basic acetate of lead, followed by an excess of ammonia. Magenta, under the same conditions, remains in solution.

From 1 to 2 grms. of cudbear (or an equivalent amount of orchil liquor) are boiled with 50 c.c. of alcohol, and afterwards diluted with 100 c.c. of water; 15 to 20 c.c. of a strong solution of basic acetate of lead (sp. gr. 1·25) are then added, followed, after stirring, by a similar quantity of strong ammonia. The mixture is filtered, and if the amount of magenta present is to be *estimated*, the precipitate is washed with a solution containing 1 part of ammonia, 5 parts of alcohol, and 10 parts of water; otherwise the washing may be neglected. With pure cudbear the filtrate is quite colourless; if magenta be present it is either colourless or pink, according to the amount of ammonia present in the solution. The liquid is then acidulated with acetic acid, when the presence or absence of magenta is at once made apparent; in the case of pure cudbear or orchil the solution remains colourless, whereas, if a salt of rosaniline be present the well-known colour of magenta is immediately developed. If further proof be wanting, a small piece of worsted yarn may be dyed in the solution and afterwards tested in the usual way with such reagents as hydrochloric acid, caustic soda, and a mixture of hydrochloric acid and stannous chloride.

By means of this method I have been able to detect with certainty 1 part of magenta in 100,000 parts of cudbear.

For determining the *amount* of magenta present I make use of a colorimetric process. A standard solution of pure magenta is prepared so as to contain 1-100th milligrm. per c.c. It is acidulated with acetic acid in order that it may be under the same conditions as the solution to be tested. The latter is made up to a known bulk, say 250 c.c. (or, if magenta present be very small, concentrated to 100 c.c. and the whole taken for estimation), and an aliquot part run into a Nessler tube and diluted to 100 c.c. The standard solution of magenta is then run from a burette into a second cylinder in such quantity that the depth of colour is equal to that in the first, as in the case of Nesslerising ammonia. The amount of magenta present in the sample of cudbear or orchil under examination can be then readily calculated. In place of Nessler tubes the colorimeter or Lovibond's tintometer might be used with advantage.

It will no doubt be apparent from what I have already stated that this method is capable of detecting very much smaller quantities of magenta than the manufacturer of cudbear would ever think of using for the purpose of adulteration. But as the amount present can, at the same time, be easily and readily estimated, there is little danger of a sample of genuine cudbear which may have become accidentally contaminated with a trace of magenta, being pronounced sophisticated.

In a valuable paper on the "Detection of Adulterations in orchil and cudbear" F. Breiul* employs basic acetate of lead for detecting magenta and other basic coal-tar colours. Some time previous to the publication of that paper, however, I tried the same reagent at the suggestion of my friend Dr. E. Knecht, but a considerable amount of cudbear still remained in solution, and it was only by adding an excess of ammonia or soda that it was completely precipitated.

3, Union Street, Bradford.

* *Journal of the Societ of Dyers and Colourists*, vol. ii., p. 23.
† *Ibid.*, vol. ii., p. 58.
‡ *Journal of the Society of Chemical Industry*, vol. v., p. 287.

VOLUMETRIC ESTIMATION OF SULPHURIC AND PHOSPHORIC ACIDS.

By JOHN TSAWOO WHITE.

THE delicate reaction of silver and chlorine with potassium chromate as indicator may be used for the estimation of sulphuric and phosphoric acids. The silver solution, 1 c.c. = 0·001 grm. Cl, as used for water analysis, will answer.

Fixed alkaline sulphates precipitated by barium chloride in excess will give an equivalent of alkaline chlorides. The excess of barium chloride precipitated by ammonium carbonate, the solution diluted to a definite volume, and a fractional volume filtered, evaporated, and ignited gently, will give the pure chloride. The alkaline chloride is dissolved and titrated, and the chlorine obtained is calculated for the total volume. Two trial experiments were undertaken. Two solutions containing 0·0349 grm. SO_3 and 0·0769 grm. SO_3 were slightly acidified with hydrochloric acid, the $BaSO_4$ and $BaCO_3$ precipitated, diluted to 250 c.c., and 50 c.c. evaporated, ignited, and titrated. The chlorine obtained was multiplied by 1·128, the factor for sulphur trioxide. The values obtained were 0·0375 grm. and 0·0741 grm. SO_3 respectively. Phosphoric acid interferes with the estimation. The sulphuric acid might, however, be determined. Separate the phosphoric acid by magnesia mixture, prepared with magnesium chloride; dilute with ammoniacal water to a certain volume, filter a known volume, evaporate to dryness, and ignite. The solution of the dissolved chlorides and sulphates is divided into two portions; one part is titrated for chlorine and the other part treated as for the estimation of sulphuric acid. The difference of the two titrations will give the chlorine equivalent of sulphuric acid. As I have not yet tried this separation I cannot state how far the magnesium chloride will interfere with the process.

Alkaline phosphates, in the tribasic form, are precipitated by silver nitrate, silver phosphate, Ag_3PO_4, being formed. Precipitating with excess of silver solution and neutralising any acid formed by calcium carbonate, the solution is diluted to 250 c.c. and 50 c.c. is filtered and titrated for the excess of silver by a solution of ammonium chloride, $As6Cl = P_2O_5$, chlorine 0·667 = phosphorus pentoxide. One trial in a solution containing 0·0152 grm. P_2O_5 gave 0·0141 grm. P_2O_5. Chlorides may be separated by evaporating with a slight excess of H_2SO_4, and then neutralising with soda before precipitating with silver nitrate.

* *Mitth. d. Techn. Gewerbemuseums in Wien*, 1887, 37.

Arsenic acid might also be determined like phosphoric acid.

Rangoon, March 29, 1888.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON FOR THE MONTH ENDING MARCH 31ST, 1888.

By WILLIAM CROOKES, F.R.S.;
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To GENERAL A. DE COURCY SCOTT, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, April 7th, 1888.

SIR,—We submit herewith the results of our analyses of the 182 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from March 1st to March 31st inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

With the exception of two samples, the whole of the 182 samples examined were clear, bright, and well filtered.

The condition of the water furnished to the Metropolis during the past month by the two Companies taking their supply wholly or chiefly from the Lea, has not differed appreciably from that observable during the previous months of the year. In the case of the Thames-derived supplies, however, the occurrence of a more or less flooded state of the river throughout the greater portion of the month was not without some influence, although indeed to no significant extent, on the character of the water. Thus, while the mean proportion of organic carbon in the Thames-derived supplies examined during January and February was 0·155 part in 100,000 parts of water, the mean proportion in the samples examined during the past month was 0·162 part. But even this proportion is not at all excessive, either absolutely or for the season of the year; while the mean proportion for the two previous months was exceptionally low for the season of the year.

The general result referred to above, as to the small extent of increased proportion of organic carbon in the Thames-derived supplies furnished during the past month, is confirmed by the results of the determination of the amounts of oxygen required to oxidise the proportions of organic matter present, and of the determinations of the degree of colour-tint of the water. That the general influence of the floods was thus inconsiderable is a testimony of some value as to the efficiency of the subsidence and filtration works of the Companies.

The influence of the condition of the river upon the water-supply is, however, made more apparent by comparing with one another the results of individual examinations made during the past and previous months respectively. Thus, during the past month, in seven instances the proportion of organic carbon was found to exceed 0·170 part in 100,000 parts of the water, giving a mean of 0·180 part; whereas during the previous two months of the year the proportion of 0·170 was exceeded in two instances only, both occurring in the month of January, when the two highest proportions for the month were found to be 0·173 and 0·188 part respectively.

The maximum proportion of organic carbon present in any one sample of Thames-derived water examined during the past month was 0·193 part in 100,000 parts of the water, equivalent to about 0·340 grain of organic matter per gallon, or to about the $\frac{1}{500}$ part of one per cent.

During the past quarter of the year we have examined 533 samples of the water furnished by the London Water Companies taking their supply from the Thames and the Lea. With two exceptions only, met with during the past month and recorded as "very slightly turbid," the whole of these samples were found to be well filtered, clear, and bright; while the mean proportion of organic carbon present in the Thames-derived samples examined was 0·157 part in 100,000 parts of the water, the three highest proportions being 0·188 part met with in a January sample, and 0·188 part and 0·193 part met with in two of the March samples.

We are, Sir,
Your obedient Servants,
WILLIAM CROOKES.
WILLIAM ODLING.
C. MEYMOTT TIDY.

A SIMPLE METHOD OF DETERMINING EQUIVALENTS FOR USE WITH LARGE CLASSES OF STUDENTS.

By JOSEPH TORREY,
Professor of Chemistry in Iowa College.

I DO not think it advisable, generally speaking, to introduce students to equivalents, atoms, molecules, &c., until they are pretty well advanced and tolerably expert analysts. The first term's work in this Laboratory is always on the metals, and the aim of the work is to accumulate results as rapidly as possible, and to familiarise the student with as many substances as possible. I believe this to be a method that prepares the mental system for theory when the time comes for it. While the freshman class were studying the action of hydrochloric acid on metals, it was noticed by some of them that some metals apparently liberated more hydrogen than others. This observation aroused considerable interest, and I thought it would be well to introduce the equivalent then and there.

The question was put as follows:—*What weight of each metal will it take to liberate one milligramme of hydrogen?*

The metals chosen for experiment were iron, zinc, and aluminium. The apparatus given to each student consisted of a 3-inch evaporating dish and a common 6-inch test-tube. In some cases graduated gas tubes were given out. 50 to 100 m.grms. of the metal having been accurately weighed, the test-tube was filled with acid (in most cases hydrochloric acid), and inverted in the evaporating dish, previously one-third filled with the same acid. The piece of metal was now quickly brought under the tube, and the whole apparatus left to itself till the solution was complete. Sometimes a gentle heat was applied. Later on it was found better to put the metal in a little cup (made by cutting off ½ inch from the lower end of a small test-tube) before bringing it under the tube, thus avoiding the possibility of bubbles being carried out by the descending current of acid. When solution was complete the tube was transferred to a large jar of water and the acid displaced by water. It was then cooled to the temperature of the room.

When graduated tubes had been employed the volume could then be read directly, the necessary corrections for temperature and pressure made, and the equivalent deduced. When ordinary test-tubes had been employed,

the line where gas ended and water began was marked on the tube by tying a piece of fine thread round it. Water was then run in from a carefully graduated burette till the space previously occupied by gas was occupied by water. The volume thus obtained represented the volume of gas obtained, and was corrected for temperature and pressure as usual.

I acknowledge the apparent crudeness and roughness of the process, but invite attention to the following results :—

Iron.	Zinc.	Aluminium.
28·2	32·68	9·006
27·8	32·65	9·004
27·69	32·46	9·004
27·78	32·36	9 000
27·74	32·52	9·000
27·75	32·40	9·03
27·93	32·60	8·995
28·03	32·45	8·988
28·11	32·48	9·07
27·90	32·35	8·887
27·89	32·50	9·100
27·80	32·39	9·12
27·85	32·22	9·010
27·97	32·62	
	32·46	

In some cases duplicate results are given, but where two results are identical they are given because they were separate results obtained by different students.

In such a crude process there are so many apparent sources of error that space would forbid a discussion of them, and I will only say that I believe the small quantities operated on cause many errors to vanish. The materials were all the purest obtainable. Great care was taken in marking and reading volumes. When heat had been used, and indeed in almost every case, the tube was —after the acid had been displaced by water, as previously stated—shaken so as to absorb most of the hydrochloric acid volatilised. The gas was usually allowed to stand for some time before being read. The burettes had been carefully compared with a calibrated standard, and any error in any one of them was not large enough to have affected the results materially.

There is of course nothing new about the process, but I have never seen any published results of its use with large classes.

Most of the work as to finding the best way of carrying out the process has been done by my Freshman class, some of whom have attained considerable skill in working it. The process as here presented is the best we have done so far.

When graduated tubes were employed the results were not as good. I think it was because the volume of gas and quantity of metal were great enough to be more appreciably affected by the inherent errors of the process. It should be said that the level of the water in the tube was always brought to the level of the water in the jar before reading the volume, and that the tube was left standing long enough to get to the temperature of the room after being placed in position.—*American Chemical Journal*, Vol. x., No. 1.

Active Crystalline Matter of the Poisoned Arrows of the Somalis, extracted from the Wood of the Ouabaio.— M. Arnaud.— The principle in question, ouabaine, forms rectangular plates, very slender, of a nacreous appearance. It is absolutely white, inodorous, and not appreciably bitter. It contains no nitrogen and does not react with colouring-matters. At a boiling heat, in presence of dilute acids, it is split up, yielding a reductive sugar. Its composition is $C_{30}H_{45}O_{12}$. It is poisonous if introduced into the circulation, but not if swallowed.—*Comptes Rendus*, Vol. cvi., No. 14.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, April 19th, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Mr. James H. Gardner was formally admitted a Fellow of the Society.

A certificate was read in favour of Mr. George Thomas Evans, The Terrace, Rhymney, Mon.

The following were elected Fellows of the Society :— Ludwig Claisen, Ph.D. ; Joseph Cowper ; William Henry Dodd ; John Gill ; Frederick Preston de Jong ; Thomas Enracht Lindsay, B.A. ; Henry John Palmer ; Eugene MacSwineef ; John George Taylor ; John Cecil Watson ; Thomas Howell Williams ; James Woodward.

The following papers were read :—

29. "*The Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and of Calcium Hydroxide.*" By W. A. Shenstone and J. Tudor Cundall.

The authors have with great care re-examined the effect of heat on hydrated calcium sulphate. They have experimented on specimens of natural as well as on others of artificial origin, and they find, contrary to the usual statements on the subject, that hydrated calcium sulphate parts with a portion of its water at moderate temperatures, *e.g.*, 40° C., and that it may be almost completely dehydrated in dry air at temperatures below 100° C. Thus a specimen of selenite heated at 70° C. for 36 hours lost 20·14 per cent of water. The effect of heat in diminishing the solubility of calcium sulphate in water at temperatures between 40° C. and 150° C. may therefore possibly be due to the unequal solubility of the hydrated and anhydrous salts.

It is pointed out that the divergent statements made on this subject by various experimenters may be ascribed to the facts :—(1) That at temperatures below 100° C. the dissociation of hydrated calcium sulphate proceeds at first very slowly, so that in an experiment continued for a short period only the effect of heat may very easily be overlooked ; and (2) that specimens of hydrated calcium sulphate of diverse origin do not always behave in the same manner under identical treatment.

The authors have not yet found any evidence of the dissociation of calcium hydroxide at moderate temperatures, even by extremely delicate and very prolonged experiments. This has led them to re-examine the influence of heat on the solubility of this compound, because previous experiments have, so far as they are aware, been made in glass vessels, which, as recent experiments have shown, may have been attacked. They find that when a saturated solution of calcium hydroxide is heated at 150° C. in a platinum tube for some hours, the resulting solution contains only 1 part of hydroxide in 3081 parts of water. There is therefore no doubt that this substance is less soluble in hot water than in cold. But there seems to be no evidence at present in favour of the view that in this case diminished solubility also may depend upon the dissociation of the hydroxide, or of some hydrate of the hydroxide.

30. "*Thermo-chemical Constants.*" By S. U. Pickering.

Heats of neutralisation, the differences between the heat of formation of similar salts of different metals, and the amounts of heat evolved on the introduction of the same radicle into various members of homologous series are often expressed by constant values the meaning of which may be easily understood ; but Thomsen (*Thermochem.*, ii.,) has also drawn attention to the fact that in many cases the heats of formation of analogous compounds, or the differences between their heats of formation, are multiples of constants. Thus :—

$P_2,O_5 = 5 \times 73,980$
$As_2,O_5 = 3 \times 73,130$
$As_2,O_3 = 2 \times 77,330$

The existence of such a relationship, the author contends, can have no possible meaning, and he accounts for the occurrence of such coincidences as being simple mathematical chances. Given a certain number of quantities, it is easy to calculate the chances against any two of these being multiples of some constant, allowing a certain latitude for error, which allowance, it may be mentioned, attains considerable dimensions in many of the cases quoted by Thomsen.

Taking each case in which an analysis of this description is possible, it is shown that there is a sufficient number of data to supply the coincidences observed by Thomsen.

He also criticises Thomsen's supposition as to the existence of a "common constant of affinity," a quantity the multiples of which by numbers up to 10 are supposed to represent various interactions, some of which are similar and others totally dissimilar (*Ber.*, v., 170; vi,, 239). This constant Thomsen takes as being 18,631 cals.; but the author contends that any other number taken at random would have given similar results. Taking, for instance, 15,000 cals., he finds that, out of the data quoted in Thomsen's second and third volumes, as many as 120 quantities are multiples of this number within the limits of error allowed by Thomsen; and out of these we may select a large number which represent actions just as analogous as many of those quoted by Thomsen. For instance—

$P,Cl_5 = 7 \times 14,998$,
$PCl_3,Cl_2 = 2 \times 14,845$,
$Ag,Cl = 2 \times 14,690$,
$K,Cl = 7 \times 15,087$,
$Mg,Cl_2 = 10 \times 15,101$,
$K,Br,Ag = 6 \times 15,038$,
$Zn,Br,Ag = 6 \times 15,160$,
$Sr,S,Ag = 7 \times 15,241$,
$Ca,I_2,Ag = 9 \times 14,993$,

31. "*The Action of Hot Copper on the Mixed Vapours of Phenol and Carbon Disulphide.*" By Prof. CARNELLEY and JOHN DUNN, University College, Dundee.

When a mixture of phenol and carbon disulphide is passed over hot copper a new diphenylene ketone, melting at 83°, is obtained isomeric with the diortho-ketone melting at 84°, already known, the interaction being—

$$2C_6H_5\cdot OH + CS_2 + 4Cu = 2Cu_2S + H_2O + C_6H_5\cdot CO\cdot C_6H_5$$

$$= 2Cu_2S + H_2O + H_2 + \cdot\begin{matrix}C_6H_4\\C_6H_4\end{matrix}\!\!>\!CO.$$

Even under favourable circumstances the yield only amounts to about 1 per cent of the total mixture employed, as by far the greater portion (about six-sevenths) of the phenol passes over unchanged.

32. "*Oxidation of Oxalic Acid by Potassium Dichromate.*" By EMIL A. WERNER.

In this paper the author gives the results of an exhaustive study of the interactions of potassium dichromate and oxalic acid under different conditions and in varying molecular proportions. The results obtained are different from those described by Mr. Bothamley in a recent communication on the above subject (*Chem. Soc. Trans.*, 1888, 159), and may be summed up in the following conclusions:—

1. The red potassium dichromoxalate,—

$K_2H_2C_2(C_2O_4)_4(OH)_2$ (Croft's salt),

is in all cases, *without exception*, a product of the interaction of potassium dichromate and hydrated oxalic acid below 200° C.

2. Neutral potassium chromate is *never* present as a product of the interaction of potassium dichromate and oxalic acid under any conditions below 200° C.

3. When the two compounds interact in the solid state, the initial temperature of the interaction, which lies between 30° and 60°, varies with the molecular proportions employed.

4. The dehydration of the oxalic acid does not affect the nature of the interaction, the anhydrous chromoxalate, $K_2Cr_2(C_2O_4)_4$, being formed in this case.

5. Water, by its solvent action, facilitates the interaction, *i.e.*, reduces the initial temperature, but is otherwise without influence on the nature of the change.

6. Seven molecules of oxalic acid is the *minimum* quantity necessary for the complete reduction of 1 mol. of potassium dichromate, and *any excess of either above this ratio remains unchanged.*

7. When the proportion of potassium dichromate to oxalic acid exceeds 1 mol. to 7 mols., and the temperature of the mixture is raised to low redness, a secondary interaction occurs between the excess of dichromate and the red chromoxalate first formed.

33. "*The Action of Phenylhydrazine on Urea and some of its Derivatives.*" By SIDNEY SKINNER, B.A., and S. RUHEMANN, Ph.D.

The authors give an account of the action of phenylhydrazine on certain compounds nearly related to urea, describing several substances which complete the series of semicarbazides and carbazides both of oxy- and thiourea, *e.g.*, diphenylcarbazide $CO(NH\cdot NH\cdot Ph)_2$, from phenylhydrazine and ethylic carbamate or urea; and diphenylsemicarbazide, $Ph\cdot HN\cdot CO\cdot NH\cdot NH\cdot Ph$, from phenylurea and phenylhydrazine. The compounds which contain two directly-linked nitrogen-atoms are found to exhibit a characteristic behaviour with mild oxidising agents—cupric sulphate and mercuric chloride—yielding coloured compounds; and in this respect they differ in a marked manner from urea. Biuret and phenylhydrazine interact to form ammonia and Pinner's phenylurazole. In the latter part of the paper the action of phenylhydrazine on parabanic acid and on alloxan is considered.

34. "*Derivatives of Phenylisobutyric Acid.*" By L. EDELEANU, Ph.D.

The derivatives described are paranitrophenylisobutyric acid, m. p. 121°; orthonitrophenylisobutyric acid, an oil; parorthodinitrophenylisobutyric acid, m. p. 89°, and its methylic salt, m. p. 76°; nitroamidophenylisobutyric acid, m. p. 138°; amidomethylhydrocarbostyril, m. p. 216°: the last-mentioned being obtained by complete reduction of the dinitro-acid.

35. "*The Logarithmic Law of Atomic Weights.*" By G. JOHNSTONE STONEY, F.R.S.

A verbal explanation was given of a paper on this subject, which the author had that day given at the Royal Society.

The following lectures will be given on Wednesday afternoons, at 4 P.M., under the auspices of the College of State Medicine:—

May 2. "The Aims and Objects of State Medicine." By R. Brudenell Carter, F.R.C.S.

May 16. "Soil in its Influence on Health." By Professor H. G. Seeley, F.R.S.

May 30. "The Organisms occurring in Fresh Water, and the Hygienic Importance of their Presence." By Inspector-General John M. Macdonald, M.D., F.R.S.

June 13. "Some of the more Important Diseases Common to Man and Animals." By G. Fleming, Esq., LL.D., C.B., &c.

June 27. "The Rise and Progress of Sanitary Engineering within the Present Century." By Sir Robert Rawlinson, K.C.B.

July 11. "Responsibility and Disease." Sir J. Crichton Browne, M.D., LL.D.

Fellows of the Chemical Society who may be interested in the lectures are invited to attend.

At the next meeting on May 3rd the following paper will be read:—

"The Determination of the Molecular Weight of the Carbohydrates." By Horace D. Brown and E. H. Morris, Ph.D.

NOTICES OF BOOKS.

Watts's Dictionary of Chemistry. Revised and entirely Re-written by H. FORSTER MORLEY, M.A., D.Sc., Fellow of and late Assistant Professor of Chemistry in University College, London, and M. M. PATTISON MUIR, M.A, Fellow and Prælector in Chemistry of Gonville and Caius College, Cambridge; assisted by Eminent Contributors. In Four Volumes. Vol. I. London: Longmans, Green, and Co.

ANY attempt to describe or to criticise "Watts's Dictionary of Chemistry" would be looked on as a very needless, if not a foolish undertaking. But in chemistry, more than in any other science, there are a number of "vera troublesome persons" who will persist in carrying on researches, revising and modifying the conclusions of their predecessors, and extending the boundaries of our knowledge. So rapid has been this process that, although only twenty-five years have gone by since the first part of the "Dictionary" appeared, a new edition has become necessary. Of this Mr. Watts was fully aware; he had taken the task in hand, and at the time of his lamented death he had written about sixty-three pages of the work as it now appears, and had issued instructions to his collaborators.

The undertaking has therefore been committed for completion to Dr. H. F. Morley and Mr. M. M. Pattison Muir, both of whom are well qualified for the task, as they have proved by the volume now before us. The plan of the work has been modified in several respects. Instead of eight volumes, besides the Supplements, the present edition will extend only to four, of 750 pages each. To render this reduction in bulk practicable certain changes have been made, which are in themselves by no means disadvantageous. The old edition was entitled "A Dictionary of Chemistry and the Allied Branches of other Sciences," whilst the present work is confined to chemistry only. Perhaps it may be questioned whether the articles "Bacteria" and "Blood," in the volume before us, are not to some extent a transgression of these limits.

An additional quantity of space is gained by the omission of the articles on chemical arts and manufactures. Such subjects will be taken up in a separate volume under the able editorship of Prof. T. E. Thorpe.

Analytical chemistry, beyond a general summary of the principles of this art and of its leading methods, has also been eliminated. An exception—concerning the propriety of which we are very doubtful—has been made in favour of arsenic, the detection and determination of which are given at considerable length. Lastly, room has been economised by the use of abbreviations. Formulæ, we are told, "are frequently employed instead of names to save space." Formulæ we must, however, remember are not necessarily briefer than names, of which instances might be found without great difficulty.

The space thus economised is required for a notice of the many additions made to chemical science since the appearance of the original edition, and, secondly, for an account of the leading physical methods of investigation used in chemistry, and of the chief results obtained.

The work of the two editors is distinctly separated. Dr. Morley has superintended the organic and Mr. Muir the inorganic portion. The list of contributors is such as to inspire the reader with confidence. We find that Mr. C. F. Cross undertakes cellulose; Prof. Dittmar, the general article on analysis; Mr. A. G. Green, the diazo-compounds; Dr. J. J. Hood, chemical change; Dr. W. D. Halliburton, blood; Prof. F. R. Japp, benzil, its ammonia derivatives, the corresponding derivatives of benzoic aldehyd, and benzoin. Prof. E. Ray Lankester furnishes an able article on bacteria; Prof. L. Meyer, of Tubingen, allotropy; Prof. Raphael Meldola, the azo-colouring-matters; Prof. W. Ostwald, affinity; Prof. Plimpton, amylamines; Prof. W. Ramsay, acids and alloys; Mr. C. O'Sullivan, arabic acid, bassorin, and cerasin. Dr. Stevenson contributes detection and estimation of poisonous alkaloids: this article, though in itself of undoubted merit, seems to us not in accordance with the determination of the editors, as expressed in the Preface, to omit "details regarding analytical processes." Prof. J. J. Thomson contributes states of aggregation; Prof. T. E. Thorpe, atmosphere; Mr. Warington, ash of organic bodies; Mr. C. J. Wilson, caoutchouc; whilst the first portion of alcohols and various special articles are from the pen of the late Mr. Watts.

After a careful examination we feel convinced that this second edition will be found indispensable by every chemist who desires to have at hand a complete and accurate summary of the present state of his science.

Elementary Chemistry, Inorganic and Organic. By W. S. FURNEAUX, F.R.G.S. London: Longmans, Green, and Co.

THIS work, which is one of "Longmans' Elementary Science Manuals," is "adapted to the requirements of of the alternative elementary syllabus of the Science and Art Department." The author hopes, however, that his treatise may also be found useful to persons who are seeking not to "pass," but to "know." We may well suppose that in a work which undertakes to discuss inorganic and organic chemistry within the compass of 150 small pages details cannot be expected. Errors, however, are absent, as it might be expected, and in very few instances only are facts expressed in such a manner as to lead the inexperienced reader astray. We might, of course, object to such statements as that nitric acid "bleaches" indigo, and that the aniline colours are produced by the "distillation" of tar. But if we were asked to state distinctly what advantage this manual presents over many others which have appeared within the last few years, we should feel at a loss. The number of elementary treatises issued in England is a perfectly exceptional feature in our scientific literature as compared with that of other countries.

The Geological Record for 1879. An Account of Work on Geology, Mineralogy, and Palæontology, published during the Year. With Supplements for 1874 to 1878. Edited by W. WHITTAKER, B.A., F.G.S., and W. H. DALTON, F.G.S. London: Taylor and Francis.

To find a work summarising the results of observation and discovery appearing eight years after date may well stagger the reader. We cannot do other than accept the apology tendered by Mr. Whittaker, that the work of contributors, sub-editors, and editors is unpaid. We must regret that such an arrangement should be necessary. We must further regret that the encroachments which the "tendencies of the age" are making upon the leisure of scientific men render unpaid work of a good quality hard to be obtained.

We learn, further, from the Preface, that in order to bring the Record up to date the mere titles only of the memoirs, &c., will in future be given, without any abstracts. This curtailment, though we fear necessary, will greatly interfere with the value of the Record.

Proceedings of the American Pharmaceutical Association at the Thirty-fifth Annual Meeting: held at Cincinnati, September, 1887. Philadelphia: The American Pharmaceutical Association.

THESE "Proceedings" commence with a report in which it is judiciously urged that progressive pharmacists should

direct their efforts towards "sweeping from the field of pharmacy all those sailing under a trade-mark, or for which a working formula is withheld.

Under "Report on the Progress of Pharmacy" we find a collection of abstracts, some of them dating back as far as 1886, and by no means entirely confined to pharmacy.

Among the minutes of the Section on Scientific Papers we find a discussion on the comparative merits of genuine vanilla and of the vanilline manufactured from pine-cones or from eugenol. The conclusion was that, to an experienced person, there is something unpleasant about the artificial product.

CORRESPONDENCE.

NEW ELEMENTS.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. liv., p. 167) there is an article by Mr. Alexander Pringle entitled, "On Some Probable New Elements." With some of your other readers may I ask the author to inform us if he has done anything further in isolating the remarkable bodies therein mentioned. I am at present engaged in a similar investigation, and naturally am anxious to assure myself that the substance under my notice has not been isolated before.—I am, &c.,

A. E.

April 19, 1888.

THE USE OF THE TERMS "ANALYSIS" AND "ASSAY."

To the Editor of the Chemical News.

Sir,—In support of their contention that the term "assay" should be limited to furnace operations conducted on metals and their ores, your correspondents Messrs. Teschemacher and Smith quote an article by the late Mr. Richard Phillips, published in the "Penny Cyclopædia" of 1833, in which a definition of the word "assay" is given, with which I perfectly agree.

But, as I polnted out in my last letter, furnace operations were those which first attained to approximate quantitative accuracy, and in 1833 almost the only substances admitting of being, or, at any rate, requiring to be, commercially assayed, were metallic ores and metallurgical products, if we except the examination of alcoholic liquors by the Excise. The same argument applies still more strongly to the use of the term by Berthier, though even he employs the adjective *dry* in conjunction with the word "assay."

But as Messrs. Teschemacher and Smith have raised the ghost of the late Mr. Phillips, and apparently regard his article published in 1833 as binding on the present users of the term "assay," I may be allowed to point out that in J. A. Phillips's "Elements of Metallurgy," published in 1874, I find a section on "The Dry Assay of Iron Ores," and another on "The Wet Assay of Iron Ores"; an article on "The Cornish Dry Assay," and another on "The Wet Assay of Copper Ores"; a section under Zinc Ores headed "Fire Assay," and another "Volumetric Assay." Similarly the "Fire Assay" and the "Humid Assay" of silver bullion are duly described. I need not multiply these references, but may simply state that Percy and other metallurgists employ the term "assay" in an equally extended sense.

Remembering the origin and meaning of the word "assay," it is strange that an attempt should be made to limit its signification to the examination of ores and metallurgical products. At any rate, the term is now so widely used that I am afraid chemists will be unwilling to abandon its application to various commercial products, such as pyrites, bleaching-powder, starch, anthracene, opium, tannin-matters, disinfecting powders, &c., &c. Nevertheless, this is a free country, and no one who has found the extended use of the term "assay" useful in the foregoing and similar instances will desire to prevent Messrs. Teschemacher and Smith from restricting their own employment of it to a series of operations which, except for gold and silver determinations, are now almost obsolete.

On precisely the same grounds that Messrs. Teschemacher and Smith object to the present extended use of the word "assay" they might logically resent the habitual application of the words alcohol, ether, ammonia, to bodies of the general character of their respective prototypes.—I am, &c.,

Alfred H. Allen.

Sheffield, April 21, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 14, April 3, 1888.

The Relations of Atmospheric Nitrogen to Vegetable Mould.—Th. Schlœsing.—The author thinking that the vapours of the mercury used in measuring the air in his first series of experiments might possibly have killed the microbia present, has repeated them with the exclusion of mercury. The results, however, were similar. Whether mercurial vapour was present or absent the quantities of nitrogen which might be supposed to be fixed are too minute to be measured by the most sensitive procedures.

Manufacture of Farmyard Manure.—P. P. Dehérain.—The black matter of the manure is produced firstly by the solution, aided by alkaline carbonates of the vasculose and the albumenoids of the straw and of the nitrogenous matter contained in the excreta of live-stock, and secondly by the transformation of the ammonia into organic matter, a change due to the vital activity of the ferments.

Sophistications of Olive Oils.—R. Brulle.—The author places in a test-tube 0·1 grm. of albumen in powder, 2 c.c. of nitric acid and 10 c.c. of the oil in question, and heats so that the acid and the oil are of the same temperature. The tube is held so that the oil and the albumen may become mixed. If the olive oil is pure the colour of the mixture is of a greenish yellow; if the oil is mixed with 5 per cent of a seed oil the shade is a distinct amber-yellow, darker as the impurity increases. This method does not, however, detect the oil known in commerce as "exotic aveline."

Detection of Impurities in Industrial Alcohols.—L. Godefroy.—The author pours into a test-tube 6 to 7 c.c. of the alcohol in question, adds a single drop of absolutely pure crystallisable benzene, shakes; adds 6 to 7 c.c. of pure sulphuric acid at 66° B., and shakes again. If reductive compounds are present more volatile than ethylic alcohol there appears a colour varying from light brown to black. If the alcohol is chemically pure there appears, in eight to ten minutes, a slight rose colour. If the mixture remains colourless it is boiled for a few minutes, when, if compounds less volatile than ethylic alcohol are present, it takes, on exposure to light, a distinct brown colour with a green fluorescence.

Bulletin de la Société Chimique de Paris. Vol. xlviii., No. 12, December 20, 1887.

The Inactose of Neutral Sugar.—E. J. Maumené.—The author, in 1870, obtained inactose, a sugar optically

inactive, by treating normal sugar with silver nitrate. Inactose does not crystallise, and does not reduce the cupropotassic solution.

Method for obtaining Definite Hydrates.—MM. Maumené and C. Limb.—The authors hold that crystals should not be dried indifferently over lime, sulphuric acid, or phosphoric acid, especially in a vacuum. They left a quantity of very pure crystals of oxalic acid for six months under a bell along with oxalic acid dried by heat. The crystals gave, on analysis, $C_2HO_4(HO)_2$. Similar crystals dried for six months over sulphuric acid gave exactly C_2HO_4.

Action of Glacial Acetic Acid upon Citrene.—J. Lafont.—The products of the reaction in heat are a dextro-rotatory citrene acetate, which, on saponification, yields a dextro-rotatory terpilenol.

Action of Formic Anhydride upon Camphene.—J. Lafont.—The combination of formic acid with the camphenes is effected with such ease that it may be used for their transformation into camphors.

On Trichloric Alcohol, and the Action of Zinc-ethyl upon the Aldehyds.— Maurice Delacre. — On causing chloral to act upon zinc-ethyl in equal mols. in presence of a sufficiency of ether a few crystals are deposited, an intermediate product between zinc-ethyl and trichlorozinc alcoholate.

On Allene.—A. Béhal.—This extensive paper is not adapted for usefnl reproduction.

The Characters of the Secondary Aromatic Diamines containing an Ethylenic Grouping.—Albert Coulson.—The ethylene diphenylamine of Hofmann has no action upon phenol-phthalein, whilst it reacts easily with methyl orange (orangé No. 3 of Poirrier). This character is common to many bases of the same family, but it decreases notably as the molecular weight increases. If the hydrochlorate or the hydrobromate of the aromatic base is treated with sodium nitrite at 0° we have a yellow precipitate fusible about 90°. If the precipitate on being brought in contact with phenols in an alkaline solution does not produce colouring-matters it is a nitroso- and not an azo-derivative, and the base in question is a secondary amine.

Study of the Alcohols produced in the Fermentation of Glycerin by Bacillus Butylicus. Formation of Normal Amylic Alcohol.—E. Charles Morin.—In this fermentation normal amylic alcohol is produced at the expense of the glycerin along with ethylic, propylic (normal), and butylic (normal) alcohols.

New Apparatus for Fractionated Distillation.—E. Claudon and E. C. Morin.—This paper requires the two accompanying cuts and the diagram.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 4.

The Boiling Temperatures of Saline Solutions and Comparisons of the Rise of the Boiling-points with the other Properties of such Solutions.— Dr. G. Th. Gerlach.—A voluminous treatise which cannot be reproduced without the numerous tables and the eight accompanylng plates.

Determination of Metallic Iron in Slags.—G. Neumann.—The author criticises the existing methods and proposes a new process, turning on the use of an apparatus here figured.

Testing Indigo-dyes.—W. Lenz.—The author deals with the question whether a sample of goods is dyed with indigo alone or with a mixture of indigo and other blue colouring-matters His method may be summarised as follows:—Threads of the material in question should give up no colouring-matter to boiling water. Alcohol at 50 and at 95 per cent (by volume) ought to extract no colour, even if gently warmed (not boiled). Solution of oxalic acid saturated in the cold, solution of borax, solution of alum at 10 per cent, and solution of ammonium molybdate at 33⅓ per cent ought not to extract any colouring-matter at a boiling heat. The borax extract, if subsequently treated with hydrochloric acid, should not turn red nor become blue on the further addition of ferric chloride. Solutions of stannous chloride and ferric chloride with the aid of heat ought entirely to destroy the blue colouring-matter. Glacial acetic acid on repeated boiling should entirely dissolve the colouring-matter. If the acetic extracts are mixed with two volumes of ether and water is added, so as to separate out the ether, the water should appear as a slightly blue solution, the main bulk of the indigo remaining in suspension at the surface of contact of the ethereal and watery stratum. This acid watery stratum should be colourless, and should not assume any colour if a little strong hydrochloric acid is allowed to fall into it through the ether. No sulphuretted hydrogen should be evolved on boiling the yarn or cloth in strong hydrochloric acid. On prolonged boiling, supersaturation with strong potassa in excess, heating, and adding a few drops of chloroform, no isonitrile should be formed.

Detection of Aniline Dyes in Red Wines, Fruit Juices, &c.—C. O. Curtman.—The author detects these colours by means of Hofmann's well-known isonitril reaction.

MEETINGS FOR THE WEEK.

MONDAY, 30th.—Medical, 8.30.
—— Society of Arts, 8. "Decoration," by G. Aitchison, A.R.A.
TUESDAY, April 1st.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Royal Institution, 3. "The Plant in the War of Nature," by Walter Gardiner. M.A. (Annual Meeting at 1.30 p.m.)
WEDNESDAY, 2nd.—Society of Arts, 8. "Drawing, a Means of Education," by T. R. Ablett.
THURSDAY, 3rd.—Royal, 4.30.
—— Royal Society Club, 6.30.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.
—— Chemical, 8. "The Determination of the Molecular Weights of the Carbohydrates," by Horace T. Brown and G. H. Morris, Ph.D. "The Action of Heat on the Salts of Tetramethylammonium," by N. Collie and Dr. Lawson. "The Action of Heat on the Salts of Tetramethylphosphonium," by N. Collie.
FRIDAY, 4th.—Geologists' Association, 8.
—— Royal Institution, 9. "The Invincible Armada: A Tercentenary Retrospect'" by J. K. Laughton, M.A., R.N.
—— Society of Arts, 8. "The Injurious Effects of Canal Irrigation on the Health of the Population of the Punjab," by Surgeon-General H. W. Bellew, C.S.I., C.I.E.
SATURDAY, 5th.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Market Value of Gas.—If the market value of a 16 candle gas be 2s. per 1000 cubic feet, what ought to be the value of an 18 candle gas per 1000 cubic feet? This question has been put on the assumption that the value is not in direct proportion to the illuminating power. The observations of anyone with commercial data at command would be of interest.—ANALYST.

Analysis of Bad Waters.—J. H. Smith (*Jour. Soc. Chem. Ind.*, April, 1887, p. 262) asserts that an alkaline solution of potassium permanganate may be boiled easily, but if any MnO_2 be present violent concussions occur. It would thus appear that "bumping" will only occur in Wanklyn's process for the determination of "albumenoid" ammonia, if the water be sufficiently bad to reduce any of the potassium permanganate to MnO_2. This affords an explanation of a fact which has often proved at the same time a trouble and a puzzle.

Earrings of Lead.—(Reply to W. T.).—Lead has not any active chemical healing properties. The Russian ladies are governed in using earrings of lead by German jewellers, who make rings thereof—being considered very painless—to bore ears with; but Muscovite ladies never wear earrings of lead. These rings are removed after a few days, when the holes are perfectly healed, and ear-wires of gold always substituted for general wear. Lead is too soft for earrings and is apt to break.—Mary Shoonen.

Goldsmith's Hall Mark and Gold Ear-Wires.—What is the reason that English gold ear-wires are never stamped with the Hall-mark? Persons who purchase such rings are always obliged to trust the shopmen as to proper legal weight of wires, which fashion has indeed made the tone even throughout all hemispheres. Does 24-carat gold ever exist in British ear-rings? I am perfectly aware that weight is legal tender for our sovereign. Any information will much oblige.—Maria Tibus.

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By Order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
April 13th, 1888.

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THE CHEMICAL NEWS.

VOL. LVII. No. 1484.

ROYAL COLLEGE OF SURGEONS OF ENGLAND LIBRARY 7 MAY 88

PRESERVATION OF SULPHURETTED HYDROGEN SOLUTION IN THE LABORATORY.

By DAVID LINDO.

As a solution of sulphuretted hydrogen in a mixture of glycerin and water is quoted on the price-lists of chemical reagents published by some houses, I infer the preparation is employed in laboratories.

According to a statement published in the CHEMICAL NEWS (vol. xv., p. 218), the suggestion to saturate dilute glycerin, instead of pure water, with the gas, originated with M. Lepage, of Gisors, who alleges the solution so prepared will keep for twelve or fifteen months, with scarcely any loss of strength.

It is stated that the dilute glycerin dissolves less of the gas than distilled water: representing the solubility in the latter liquid by 100, that in the former will be 60. It is also said that glycerin prevents solution of ammonium sulphide from becoming yellow.

In this paper I have recorded the results of experiments undertaken to ascertain if there is really any advantage in using the solvent for the gas, proposed by Lepage, instead of distilled water.

I have not found that glycerin prevents solution of sulphide of ammonium from becoming yellow.

The first requisite in pursuing an enquiry of this kind is a rapid and accurate method for estimating the strength of the gas solutions. For aqueous and *recently* prepared dilute glycerin solutions, as well as for some others tried, I know of no better process than precipitating with silver nitrate in presence of excess of ammonia, and weighing. Such a method, however, would not be rapid if a paper filter were employed, since the precipitate and filter would either have to be dried at 100°—a tedious proceeding, and not likely to give accurate results—or the whole would have to be burnt and reduced in a current of hydrogen.

By using Gooch's method of filtration the process is rendered expeditious and accurate.

I employ as reagents a solution of silver nitrate containing 1 grm. of the salt in 20 c.c., and a 6 to 7 per cent solution of ammonia. The quantity of gas solution used for each test may be 5 or 10 c.c., according to the strength.

Five to 12 c.c. silver solution—according to the supposed strength of the gas solution and quantity to be tested—are placed in a small beaker, 10 c.c. water and 10 to 15 c.c. ammonia added, the gas solution measured with a pipette, and run in. Warming gently and stirring greatly facilitates subsidence of the precipitate, which is to be rubbed down with a glass rod, washed three or four times by decantation, transferred with a trimmed feather to the Gooch crucible, the washing completed, and a few c.c. of alcohol passed through. Dry on the water-bath. The precipitate, if pure, will contain 12·91 per cent sulphur.

I have compared the results with those obtained by reducing in hydrogen and weighing the silver.

First Experiment.—A weak aqueous solution of the gas taken. 10 c.c. precipitated and weighed as sulphide gave 0·0439 grm. = 0·00566 sulphur. 10 c.c. precipitated, filtered through pure paper, dried, burnt, and ignited in hydrogen, gave 0·0376 silver = 0·00557 sulphur.

Second Experiment.—Water saturated at low temperature, and the gas fixed by adding soda. 5 c.c. (at ordinary temperature) gave 0·1594 sulphide silver = 0·0206 sulphur. 5 c.c. gave by ignition in hydrogen 0·1382 silver = 0·0205 sulphur.

Third Experiment.—Camphored water at low temperature; gas passed, but not to saturation; fixed with soda. 5 c.c. gave 0·1376 sulphide = 0·0178 sulphur. 5 c.c. gave by ignition in hydrogen 0·1196 silver = 0·0177 sulphur.

Common camphor, boric acid, thymol in small quantity, have each been tried as preservative agents: the first and last appear to retard oxidation, but the solutions lose strength chiefly in consequence of the gas escaping from them, and none of these substances will check loss from this cause.

The gas in all such mixtures can be accurately estimated by the silver method, and also, as stated above, in dilute glycerin solutions, provided they are fresh; at least this is my experience with the samples of glycerin employed, which were of the best quality.

If the glycerin solutions, however, are kept for some time, fermentative change occurs, and the silver method is no longer available, the results coming out too high. In this case I precipitate with arsenious acid, using a solution of the acid in excess of sodic carbonate, followed by HCl in some excess, and weigh the orpiment after drying on the water-bath. The method is rather troublesome, and requires some practice, as the precipitate is difficult to wash. It retains traces of chlorides with immense force, and, if the washing is not arrested before the chlorine reaction quite ceases, the protracted exposure will cause sufficient loss by oxidation to lower the results sensibly. I used the Gooch method of filtration, and experienced no great difficulty with precipitates weighing not much over 0·030 grm., but without some device to render filtration more rapid precipitates weighing 0·050 to 0·070 grm. could not be managed. Fissures generally appear in the precipitate, and if these are allowed to remain open the water passes quickly, but does not wash the precipitate. If the cracks are closed with a glass rod the washing may occupy hours, and the result would then be worthless. I have washed these large precipitates in less than an hour, by adding about twice their supposed weight of prepared asbestos (prepared as for filtering) to the mixture to be precipitated before running in HCl. The orpiment, on adding the acid, goes down well mixed with the asbestos, forming a mass which does not crack on applying suction, and can be washed with comparative ease. The best plan, however, with strong solutions of the gas, is to take only 5 c.c. accurately measured, which will give a weight of orpiment not difficult to manage. The precipitate, if pure, will contain 39·02 per cent sulphur. Results, compared with those obtained by the silver method, are given in Table I., various solvents being used for the gas, and weak and strong solutions of the latter. 10 c.c. taken for each test.

TABLE I.

Solvent.	By silver, wt. of ppt. in grm. = S.	By arsenic, wt. of ppt. in grm. = S.
A. Water	0·2520 = 0·0325	0·0799 = 0·0312
B. Camphored water	0·2234 = 0·0288	0·0718 = 0·0280
C. Water and traces of thymol ..	0·0796 = 0·0103	0·0258 = 0·0101
D. (1) Water	0·1588 = 0·0205	0·0507 = 0·0198
(2) Water	0·1586 = 0·0205	— —
E. Glycerin and water, equal vols.	0 0967 = 0·0125	0·0310 = 0·0121
F. Camphored water	0·0439 = 0·0057	0·0140 = 0·0055
G. Water	0·0360 = 0·0046	0·0115 = 0·0045
H. Camphored water	0·0263 = 0·0034	0·0081 = 0·0032

Taking results by the silver method as correct, the experiments have shown that the arsenic method will give results on an average 3 to 4 per cent below the truth: a correction of 4 per cent will be made in future, which will

give results sufficiently accurate for all practical purposes. In experiments that follow the arsenic method has only been used in testing glycerin solutions not recently prepared.

The earliest results obtained seemed to indicate there was little or nothing to be gained by using a mixture of glycerin and water, instead of pure water, as a solvent for the gas. Oxidation is not prevented by the glycerin,—seems, on the contrary, to be rather increased by its presence; the solution soon becomes turbid, remains so for months, and deposits a good deal of sulphur. On the other hand, the gas does not escape so rapidly from a mixture of glycerin and water as it does from pure water; but if both are saturated at the start the aqueous solution will of course be the strongest, and experiments have shown it will remain so until the strength of both is considerably reduced.

Experiments.—Two reagent bottles were taken of the same shape, and about the same capacity; measuring to the bottom of stoppers No. 1 0·273 c.c., No. 2 0·278 c.c. In No. 1 placed 200 c.c. distilled water, in No. 2 200 c.c. of a mixture. Glycerin 4, water 5, by volume. Passed gas until both were thought to be saturated. Removed 5 c.c. from each with a pipette, and estimated strengths by silver. Temperature 25·6°, weights in grammes:—

No. 1. Water, 5 c.c. gave precipitate .. .. 0·1046=0·0135 S.
No. 2. Glycerin and water, 5 c.c. gave precipitate .. .. 0·0740=0·0096 S.

The stoppers were removed, and a cylindrical tin cover 8×9 ins. placed over the open bottles. Every two hours 5 c.c. were removed from each, and the strengths estimated. I have given the strengths after four hours and after ten hours, when both were so reduced that it was unnecessary to carry the experiment further.

After four hours. Temperature 27·8°:—
No. 1. Water, 5 c.c. gave precipitate .. .. 0·0658=0·0085 S.
No. 2, Glycerin and water, 5 c.c. gave precipitate .. .. 0·0600=0·0077 S.
After ten hours. Temperature 29°:—
No. 1. Water, 5 c.c. gave precipitate .. .. 0·0380=0·0049 S.
No. 2. Glycerin and water, 5 c.c. gave precipitate .. .. 0·0418=0·0054 S.

The solutions remained quite clear to the end.

2nd. The bottles were charged with fresh solutions, but reversed, No. 1 being used for the glycerin and water, and No. 2 for the aqueous solution. The strengths were estimated immediately after passing the gas; five hours after, and ten hours after, the bottles being kept under cover, with the stoppers out, as in the first experiment. Temperature 26·5°:—

No. 1. Glycerin and water, 5 c.c. gave precipitate .. .. 0·0820=0·0106 S.
No. 2. Water, 5 c.c. gave precipitate .. .. 0·1008=0·0130 S.
After five hours. Temperature 29·8°:—
No. 1. Glycerin and water, 5 c.c. gave precipitate .. .. 0·0556=0·0072 S.
No. 2. Water, 5 c.c. gave precipitate .. .. 0·0596=0·0077 S.
After ten hours. Temperature 30·1°:—
No. 1. Glycerin and water, 5 c.c. gave precipitate .. .. 0·0454=0·0059 S.
No. 2. Water, 5 c.c. gave precipitate .. .. 0·0356=0·0046 S.

Results of experiments made with closed bottles were not as favourable as the above for the glycerin mixture. As the average temperature here is high, there is considerable difficulty in conducting such experiments. Unless the stoppers are secured they are apt to jump out or get loosened from the internal pressure; reagent bottles with flat conical stoppers are quite unsuitable for the purpose. Without a lubricant no stoppers fit accurately enough to give even fairly concordant results with the same solution, and unless these can be secured it is obviously a waste of time to attempt comparative experiments between one solution and another.

The bottles used in the following experiments are made of very pale blue glass, and are the kind employed by manufacturers for putting up liquor ammonia and acids. I imported them with the stoppers ground with more than ordinary care, and used pure paraffin wax as a lubricant. Five were employed for aqueous solutions and four for glycerin: one of the latter unfortunately got broken before the experiments were completed.

The volume of liquid placed in each bottle was 530 c.c. A rapid current of gas was passed through the water in each bottle for forty minutes, though previous experiments had shown twenty minutes often sufficed to saturate this volume of water in a similar bottle at the average temperature of the Laboratory. The mixture of glycerin and water, 4 : 5 by volume, required a longer time for saturation.

The gas was passed forty minutes through the 530 c.c.; the materials for generating (sulphide of iron and dilute sulphuric acid) renewed, and the gas passed again for thirty or forty minutes. The strengths were estimated at once by removing 10 c.c. from each bottle with a pipette, and running into a small beaker containing the silver mixture.

The bottles were then closed with the waxed stoppers, all placed in the same cupboard, and securely wedged up up with books and folds of paper between two shelves.

Every week, for five weeks, 10 c.c. was carefully poured out of each and thrown away. Every six weeks 10 c.c. of the fluid, free from sediment, was removed with a pipette from each, and the strength estimated.

The bottles were charged 23rd to 26th May, 1887, and the experiments, continued as described above, without interruption, until August.

From an unavoidable cause I was obliged to leave the bottles undisturbed from August until near the end of October, when the experiments were resumed, and continued until February this year. The average temperature calculated for the whole period was about 26°, the highest record being 31·3° and the lowest 21·8°.

In the following Table I have given the capacities of the bottles with the stoppers in; deducting 520 c.c. in each case will give the air space in each bottle at the commencement, after removing the first 10 c.c. for estimation. I have given the strengths at the commencement and at the end of the experiments, which is all that it is necessary to give here.

TABLE II.

Aqueous Solutions.

Capacities of Bottles.	10 c.c. gave in May, '87, Silver ppt. = S.	10 c.c. gave in Feb., '88, Silver ppt. = S.
1. 562·5 c.c.	0·2008 = 0·0259	0·0569 = 0·0073
2. 571·0 ,,	0·1924 = 0·0248	0·0541 = 0·0070
3. 569·5 ,,	0·2012 = 0·0260	0·0688 = 0·0089
4. 556·5 ,,	0·2007 = 0·0259	0·0661 = 0·0085
5. 565·5 ,,	0·1980 = 0·0256	0·0606 = 0·0078

Glycerin and Water Solutions.

		Arsenic ppt. corrected.
1. 566·5 c.c.	0·1570 = 0·0203	0·0175 = 0·0068
2. 570·0 ,,	0·1598 = 0·0206	0·0180 = 0·0070
3. 569·5 ,,	0·1560 = 0·0201	0·0146 = 0·0057

These results seem clearly to show that there is nothing to be gained, at least in this climate, by using a mixture of glycerin and water, instead of pure water, as a solvent for the gas. A number of experiments had been made previous to the above, the results of which pointed to the same conclusion, but, doubting if sufficient precautions

had been taken to secure reliable results, the experiments here recorded were undertaken.

Falmouth, Jamaica, B.W.I.,
March 20th, 1888.

ON THE

SUPPOSED DISSOCIATION OF ZINC OXIDE, AND THE CONDITION OF THE ATMOSPHERE WITHIN A PLATINUM VESSEL HEATED BY A GAS FLAME.

By H. N. MORSE and W. M. BURTON.

Some years ago it was found by one of us that zinc, in the highest state of purity and in considerable quantity, can be prepared by subjecting the metal to fractional distillation in a vacuum. When the pressure is wholly removed the zinc distils at a temperature apparently not much above its fusing-point, while the other metals usually associated with it are at that temperature very much more or very much less volatile. The separation of zinc from lead by this method is especially rapid and satisfactory. It seemed desirable, therefore, that a re-determination of the atomic weight of the metal, with the elementary substance as a starting point, should be undertaken.

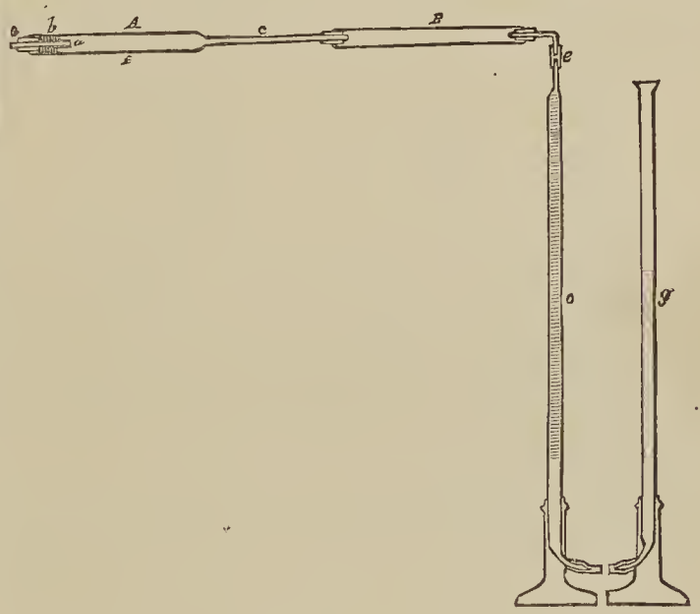
Of all the methods which have been employed for the purpose, or which suggested themselves as feasible, the determination by means of the oxide appeared to be the most simple and direct, and therefore the best, provided the stability of the oxide at high temperatures could be demonstrated. The details of our work will be published at a later date; but some of the results having a more general interest, we venture to present them now. Having demonstrated that the oxide of zinc does not lose weight when heated for many hours in the muffle furnace to a temperature above that required to fuse steel; moreover, that the platinum crucibles containing the oxide do not exhibit any trace of tarnish after such heating; we turned our attention to a phenomenon which must be familiar to many chemists, namely, that when the oxide of zinc is heated in platinum over a blast-lamp, or even over an efficient simple burner without blast, it constantly loses weight.

Axell Erdmann* observed, while making a determination of the atomic weight of zinc, that when the oxide is heated in a crucible the platinum becomes coated with a blue tarnish supposed to be an alloy of zinc and platinum. Much later Marignac† noticed the same tarnish upon the platinum when the oxide is heated over the blast-lamp; moreover, that there is a manifest distillation of the zinc out of the crucible and a constant loss in weight. This loss he ascribes to *dissociation* of the oxide.

In view of the results of Deville‡ relating to the dissociation temperature of water, and of Deville and Troost§ relating to the permeability at high temperatures of platinum to hydrogen, it appeared probable to us that the phenomenon is one of *reduction* and not of *dissociation*; that the temperature of the gas flame in parts being above that at which the dissociation of water begins, there is in the flame at the same time free oxygen and free hydrogen resulting from the dissociation of water previously formed by the combustion of the gas. The result would be an accumulation of free hydrogen on the inside of any platinum vessel heated in the gas flame, due to the more rapid diffusion of hydrogen through heated platinum. Our results have justified this explanation, and make it appear probable that the atmosphere within a platinum vessel heated by such flames as are employed in the laboratory is always a *reducing* atmosphere.

* *Ann. Chem.* (Liebig), l., 438.
† *Archives des Sciences Phys. et Nat.* (3), x., 193.
‡ *Jsb. Chem.*, 1860, 24.
§ *Ibid.*, 1863, 23.

The method of experimentation consisted in heating with a lamp the air contained in a platinum tube so arranged that the pressure could be varied at will; withdrawing it afterwards, and determining to what extent the oxygen had been converted into water. The figure exhibits the apparatus employed. A is a platinum tube; B, a glass tube of such capacity that A and B together hold about 130 c.c.; C, a Hempel burette. On the inlet tube, *a*, a number of discs, cut from asbestos board and ignited to destroy organic matter, are placed in order to protect the cork from the heat. The platinum tube is also cooled at the points *b* and *c* by wrapping with cloth which is kept wet by means of a dripping arrangement placed above. The tubes A and B are filled with air from the outside of the laboratary, closed at *d*, and connected at *e* with the gas burette, which was previously full of water. The flame is applied at *f*. When the air within has attained its maximum expansion, the level of the water in *g* is adjusted according to the pressure which it is desired to maintain in the apparatus. At the end of each ten minute period of heating the tube is allowed to cool down, in order to facilitate the mixing of the portions of the gas in A, B, and C. Finally a small glass tube, filled with water and dipping under water in a beaker, is attached at *d*; the gas withdrawn by lowering *g*, and analysed by the method of Hempel. The substances looked for, and determined when found, were carbon dioxide, oxygen, carbon monoxide, hydrogen, and nitrogen.



The quantity of carbon dioxide found was not in any case in excess of the quantity normally contained in the air, and was, of course, hardly measurable in the ordinary Hempel burette. Carbon monoxide was not found at all. The hydrogen was determined by absorption in palladium sponge, the tube containing it having first been filled with pure nitrogen. The fact that the air did not perceptibly diminish in volume when treated with caustic potassa to withdraw carbon dioxide, proves that no oxides of nitrogen were formed during the heating. Great care was taken in all cases, to use only an oxidising flame, and not to allow the internal cone containing the unburned gases to come in contact with the platinum tube. The results obtained are stated in Table I. The percentages of oxygen given represent the proportion of that element which *disappeared* during the heating, and are calculated on the basis that the air contains 20·9 per cent of oxygen and 79·1 per cent of nitrogen. The quantities of free hydrogen found are given in cubic centimetres.

In Table II. are given the number of c.c. of oxygen burned out in each experiment, also the minimum volume of free hydrogen which must have diffused from the flame into the tube. The calculation is, of course, based on

Table I.

No. of Exp.	Source of Heat.	Time of Heating.	Pressure.	Per cent of total Oxygen lost.	C.c. free Hydrogen found.
1.	Blast lamp.	1 Hour.	Atmos. press. less 30 m.m. Merc.	63·07	
2.	,,	1 ,,	,, ,,	62·08	
3.	,,	1 ,,	Atmos. press.	53·70	
4.	,,	1 ,,	,,	54·13	
5.	,,	1 ,,	Atmos. press.+30 m.m. Merc.	48·67	
6.	,,	2 ,,	Atmos. press.	88·49	
7.	,,	2 ,,	,,	88·53	
8.	,,	3 ,,	,,	98·14	2·4
9.	,,	4 ,,	,,	100·00	2·7
10.	Simple Bunsen burner without blast.	3 ,,	,,	55·56	
11.		6 ,,	,,	81·81	
12.		10 ,,	,,	97·00	0·7

the supposition that the residual nitrogen is to the oxygen originally mingled with it as 79·1 is to 20·9.

Table II.

No. of Exp.	Vol. of O_2 lost.	Min. vol of H_2.	
1.	13·75 c.c.	27·50 c.c.	
2.	14·89	29·78	
3.	11·40	22·80	
4.	11·41	22·82	
5.	10·43	20·86	
6.	21·73	43·46	
7.	22·28	44·56	
8.	21·03	2·4 42·06	44·46
9.	22·75	2·70 45·50	48·20
10.	12·50	25·00	
11.	19·80	39·60	
12.	22·81	0·70 45·62	46·32

If we compare the results of experiments Nos. 1 and 2 with 3 and 4, and with 5, it appears that the diffusion of hydrogen from the flame through platinum is affected by difference in pressure, being greater when the pressure on the inside is diminished. It appears from experiments Nos. 8 and 12 that when the oxygen has been reduced to a small quantity, both free oxygen and free hydrogen may exist together in the tube.

Experiment No. 9 was undertaken in order to determine whether it is possible wholly to remove the oxygen, and the fact that the volume did not perceptibly decrease when the gas was passed into the phosphorus absorption pipette indicates that it may. But the gas, when it was returned to the burette for measurement, appeared to contain a minute quantity of the white clouds which appear when oxygen is absorbed by phosphorus. To settle this question satisfactorily, finer measuring apparatus and greater precautions against possible diffusion of oxygen from the outside will be required.

That the quantity of free hydrogen found in Experiment No. 9 was not markedly larger than that found in No. 8 is not surprising, because, the tube being hot on all sides, it passes out of the rear wall with nearly the same facility that it enters in front. Moreover, the connections are necessarily such that free hydrogen would be lost through them. It was our first plan to fill the tube with some gas free from oxygen, and to measure the hydrogen which accumulated in it; but the reflection that free hydrogen was not likely under the circumstances to accumulate with rapidity, and that the quantity found afterwards would be no measure of that which had diffused in during the experiment, led us to select air instead.

Our results appear to explain sufficiently the cause of the constant loss in weight when the oxide of zinc is heated in platinum over a gas flame, and to make it extremely probable that the atmosphere within any platinum vessel heated by any gas flame whatever, will receive free hydrogen. They also explain the origin of many of those tarnishes and sublimates which the analytical chemist so often finds on the inside of his crucible after heating substances supposed to be non-volatile. Since only the so-called oxidising portions of the flames were allowed to come in contact with the platinum, the free hydrogen which diffused through the metal must have been produced by the dissociation of water. Whether this dissociation is due solely to the high temperature of the flame, or in part to the influence of the platinum itself, is a question for further investigation. It appears not improbable that the very different rates of diffusion of hydrogen and oxygen through platinum at high temperatures may be a cause of the dissociation of the highly heated water vapour, just as different rates of diffusion through liquids of the constituents of some compounds may determine their decomposition while undergoing solution.

The idea suggests itself in this connection that the oxidising effect of the outer blowpipe flame may be due to the oxygen derived from dissociating water, rather than from the excess of oxygen blown into it. Such a supposition accords well with the common experience that the best oxidising effects are produced by the *hottest* flame, and not by the flame into which a large excess of air is pumped. A molecule of water heated to a temperature at which it becomes unstable would doubtless be a more active oxidising agent than a molecule of free oxygen.—*American Chemical Journal*, vol., x. No. 2.

THE CHEMICAL STRUCTURE OF THE NATURAL SILICATES.*

By F. W. CLARKE.

In any attempt to discuss the chemical structure of the inorganic silicates we are met at the outset by difficulties which are partly real and in part imaginary. On the one hand we have to deal entirely with non-volatile solids, of which, because of their fixedness, we cannot certainly ascertain the true molecular weights. They are, furthermore, insoluble and, chemically speaking, non-plastic; that is, they yield but stubbornly to reagents, so that the changes of which they are structurally capable can rarely be studied in the laboratory. These difficulties are very real. On the other hand, most of the definite silicates are natural minerals, and as such are commonly supposed to have a bewildering complexity of constitution. This difficulty is only apparent, not real, and is due to several causes. First, few mineral species occur in a state of even approximate chemical purity; and secondly, many of them, being isomorphous, crystallise together to form seemingly homogeneous bodies to which rational formulæ can hardly be assigned. Impurities, indefinite crystalline mixtures, and defective analyses account for many apparent complications. Eliminate from any group of natural silicates these disturbing conditions, and we shall

* *American Chemical Journal*, Vol. x., No. 2.

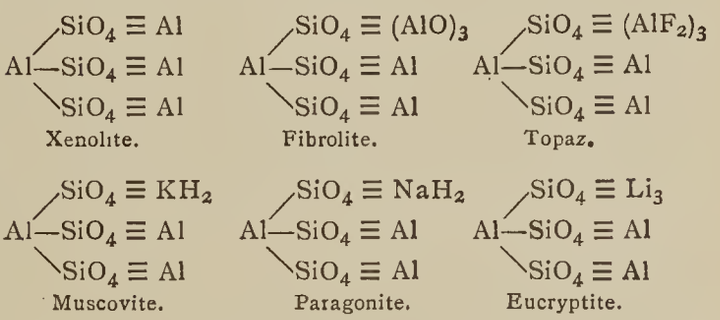
find in every case a simplicity of composition far removed from the complexity which is popularly assumed. Even on theoretical grounds we should expect simplicity of structure. The mineral silicates are, as a rule, exceedingly stable compounds, while complex molecules are relatively unstable. They are formed in nature under conditions of high temperature, or are deposited from solutions in which many reactions are simultaneously possible; circumstances that are strongly adverse to any great complications of structure. Finally, they are quite limited in number, only a few hundred at most being known; whereas, if complexity was the rule among them, slight variations in origin would produce great variations in character and millions of different minerals would be generated. That few substitutions occur is presumptive evidence that only few are possible, and hence simplicity of constitution is to be inferred. In fact we find the same small range of mineral species occurring under the same associations in thousands of widely separated localities, a few typical forms containing a few of the commonest metals being almost universally distributed. The longer the evidence is considered, the more overwhelming the argument for simple silicate structures becomes.

Suppose now that for any given silicate the empirical composition has been ascertained, how can its chemical structure be determined? We cannot measure its vapour density and so deduce its molecular weight; but the problem is not, therefore, necessarily hopeless. Several lines of available evidence are open. In some cases the compound may be synthetically reproduced in the laboratory, a kind of mineralogical investigation in which rapid progress is now being made. Again, the constant association of the species with certain others sheds light upon its genesis, and still oftener its alterations in nature furnish important details. An alteration product, despised by the crystallographer, is really a record of chemical change, and such products may be of the highest scientific interest. In a few researches they have been produced artificially by reactions which were prolonged for months at a time, and so a mass of evidence is slowly accumulating, strictly analogous in kind to that which the organic chemist chiefly depends upon for ascertaining the structure of a hydrocarbon. All these lines of evidence are legitimate, and all converge towards truly scientific conclusions. We know that certain silicates originated together, and that each alters in certain definite ways; and from these facts we may draw perfectly fair inferences as to chemical structure, and deduce rational formulæ which shall give fuller expression to our knowledge. The evidence for such formulæ is less perfect than that at the command of the carbon chemist, but it is none the less substantial so far as it goes. It is, furthermore, cumulative.

About three years ago, while I was working tentatively at the problem now under discussion, I received for examination certain specimens of topaz which were deeply altered upon their surfaces. Upon investigation the alteration product proved to be a variety of muscovite, and a study of the empirical formulæ of the two minerals revealed an unexpected relation between them. Further study brought out more extended relations connecting them with several other silicates, and by a natural series of steps I was led to adopt as a working hypothesis the supposition that double salts might be regared as substitution derivatives of normal salts. This hypothesis, since then steadily applied to the discussion of the silicates, appears to be supported by a weighty mass of evidence, and it leads to the development of a series of structural formulæ which satisfy many conditions. They express and interpret known relations, lead to the detection of others, and point out suggestive and profitable lines of research. By these tests any hypothesis must stand or fall, and one which, meeting them successfully, has at the same time philosophical significance, may be fairly looked upon as valid.

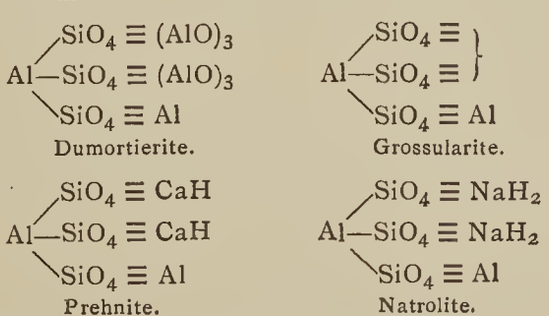
That the great majority of the natural silicates are double salts need hardly be stated, and that a very great number of them contain aluminum is also a commonplace of chemistry. Of the latter some are orthosilicates, and some are meta-compounds; and the problem is to show how each series may be derived from its corresponding normal salt. As the orthosilicates are the most important, we may begin with their consideration. They represent the maximum of complication and offer the greatest difficulties.

Fortunately, the orthosilicate of aluminum, $Al_4(SiO_4)_3$, occurs in nature as the mineral xenolite. This species, which is now well established, was long thought to be an impure variety of fibrolite, Al_2SiO_5; and in their optical properties the two are apparently identical. Fibrolite bears the closest of relations to its isomer, andalusite; and to the latter, topaz, $Al_2SiO_4F_2$, is crystallographically akin. Topaz, as I have already stated, alters into muscovite, $Al_3KH_2(SiO_4)_3$; and so also does eucryptite, $AlLiSiO_4$. To these compounds we may add paragonite, which is merely a sodium mica, and we have at least six silicates, including the normal salt, which are all evidently related to each other. That their empirical formulæ show little or no connection is due to the fact that they do not represent true molecular weights, and on this point our fundamental hypothesis gives us a key to the problem. If we triple the formulæ given for fibrolite, topaz, and eucryptite, the substitution theory which I have suggested at once becomes applicable, and the derivation of all the others from xenolite is easy. The following structures will make this conception clear:—



In the second of these formulæ the univalent group —Al=O is assumed, and in the third we have the corresponding group —Al=F_2. I think no chemist will regard these assumptions as strained.

Now the foregoing symbols all represent a series of salts derived from the first one by various substitutions of a single aluminum atom. But further replacements are theoretically possible, and the following minerals seem to illustrate them:—



Dumortierite, which has been little studied, appears to be related to fibrolite, and the formulæ exhibit a relation. Grossularite, the lime alumina garnet, is a common associate of muscovite, a fact which lends verisimilitude to the formula given above. The other two formulæ represent the known composition of prehnite and natrolite, but whether they indicate any deeper relations is not yet proven. They do, however, suggest lines of investigation, and so far fulfil a useful purpose. If they are true, prehnite should be derivable from garnet, and garnet and muscovite ought to be mutually derivable from each other. That garnets do alter into micas is already well known, although the exact character of the change is undetermined,

and the micas involved in the reaction appear to be more complex than muscovite.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

PHYSICAL SOCIETY.

April 28th, 1888.

Professor REINOLD, F.R.S., President, in the Chair.

MESSRS. W. H. Snell and A. W. Slater were elected Members of the Society.

The following communications were read :—

"*On Electromotive Force by Contact.*" By Mr. C. V. BURTON, B.Sc.

The object of the paper is to discuss the seats of the electromotive forces developed by the contact of conductors. By considering the distribution of electricity on the surfaces of the conductors, and from the fact that the potential throughout their masses are constant except about a thin layer near the junction, the author deduces that *the molecular action which gives rise to a contact E.M.F. between two conductors is confined to the immediate neighbourhood of the junction.*

If E be the contact E.M.F., and M the quantity of electricity which passes across the junction when two metals originally at the same potential are placed in contact, it is shown that the work done is E M, half of which is spent in producing heat and half in raising the potential energy of the system. Since the conductors are supposed to be kept at constant temperature, and the action which gives rise to the E.M.F. is confined to the immediate neighbourhood of the junction, the molecular energy must be absorbed *at the junction.* By supposing the surface of contact very small and the capacity of the system large, it is shown that *heat* and *chemical action* are the only kinds of energy which fulfil the required conditions of supplying an indefinite amount of energy. Hence for substances chemically inactive *the true contact E.M.F. is equal to their coefficient of the Peltier effect expressed in absolute measure* ; and for substances chemically active, but devoid of Peltier effect, *the E.M.F. is equal to the energy of combination of one electro-chemical equivalent.*

Since metal-metal contacts can only be the seats of Peltier E.M.F.'s, it is inferred that the *apparent contact E.M.F.* (measured inductively) must be due chiefly to air-metal contacts.

A list of analogous properties of Peltier and chemical E.M.F.'s is given in parallel columns. The results of some experiments on the contact E.M.F. of glass and ebonite with mercury are tabulated, but they are very irregular, and the author concludes that there is no true and definite contact E.M.F. between conductors and non-conductors.

Profs. AYRTON, SCHUSTER, THOMPSON, and PERRY discussed the points raised, and it was considered that direct experiment on contact E.M.F. in a very perfect vacuum could alone decide the questions.

"*On a Theory concerning the Sudden Loss of Magnetic Properties of Iron and Nickel.*" By Mr. H. TOMLINSON, B.A.

Experiments by himself and other observers have shown that the temperatures at which iron and nickel lose their magnetic properties depend on the specimens used and the magnetising forces employed ; but the temperatures at which they *begin to lose* these properties are definite,—for nickel about 300° C., and iron about 680° C. The author's own experiments on "Recalescence of Iron" show two critical temperatures ; and Pinchon has shown by calorimetric measurement, that between 660° and 720° C., and between 1000° and 1050° C., heat becomes latent. All these facts seem to indicate a molecular rearrangement about these temperatures.

In his proposed theory he assumes that the molecules of iron (say) contain magnetic atoms capable of motions of translation and of rotation. These tend to form closed magnetic circuits, but at ordinary temperatures are unable to do so on account of the close proximity of their centres. On raising the temperature their centres are further separated, till at about 680° C. their polar extremities rush together, forming complete circuits and exhibiting no external magnetic properties. On cooling down, the centres approach until the gravitation attraction overcomes the magnetic attraction of their poles, when the magnetic properties reappear.

Prof. AYRTON asked whether the author had made experiments on the reappearance of magnetic properties when raised to a white heat, and Prof. THOMPSON enquired whether cobalt had been tested. Both questions were answered negatively.

"*Note on the Graphic Treatment of the Lamont-Frolich Formula for Induced Magnetism*," By Prof. S. P. THOMPSON, D.Sc.

The formula referred to is—

$$N = \bar{N}\,\frac{Si}{Si + b},$$

where $\bar{N}$ = total induction when saturated, N = induction due to Si ampère turns, and b = value of Si, which makes $N = \frac{1}{2}\bar{N}$. Simple geometrical constructions are given for plotting the curve when $\bar{N}$ and b are known, and for finding $\bar{N}$ and b when two pairs of values of N and Si have been determined.

The use of the formula is shown to be justified in practice, for, as pointed out to the author by Prof. PERRY, the curves connecting permeability, μ, and induction, B, are straight lines from B = 7000 to B = 16000, between which dynamos are usually worked. A method of predetermining $\bar{N}$ and b is given for magnetic circuits of known form and materials, thus removing the objection often urged against the above formula, viz., that it involves two constants which had to be determined after the magnet was made.

Two other "Notes," by the same author, were postponed till next meeting.

NOTICES OF BOOKS.

A Treatise on Electricity and Magnetism. By E. MASCART, Professor in the College de France, and J. JOUBERT, Professor in the College Rollin. Translated by E. ATKINSON, Ph.D., F.C.S., late Professor of Experimental Science in the Staff College. Vol. II.—Methods of Measurement and Applications. London : T. De la Rue and Co.

The translator of this work, Dr. Atkinson, is of course favourably known to scientific and technical men in England, from his version of Ganot's "Physics," now generally recognised as a valuable text-book. The authors, MM. Mascart and Joubert, are also authorities of well-known merit and eminence.

The first three parts of the present volume are respectively devoted to methods of measurement, to electrical measurements, and to magnetic measurements.

The fourth part, under the peculiar title "Complement," treats of industrial applications and numerical constants. The applications here taken into consideration are chiefly those in which it is intended to utilise the electrical energy itself, as in galvano-plastics, lightning, or the transmission of mechanical power. The subject of galvano-plastics is very cursorily dealt with, and

electro-metallurgy, or the reduction of ores by the current, and the electric furnace are overlooked.

To readers well versed in the higher mathematics the work will be of great value, but to all others it must prove simply unintelligible. In the chemical formulæ introduced the old notation has been retained, copper sulphate, *e. g.*, being written CuO,SO_3+5HO.

There is a brief table of contents at the beginning of the volume, a very complete "index of subjects" at the conclusion, with references to pages, followed by an ordinary index for both volumes, in which the references are to paragraphs.

Organic Analysis: a Manual of the Descriptive and Analytical Chemistry of Certain Carbon Compounds in Common Use. For the Qualitative and Quantitative Analysis of Organic Materials; Commercial and Pharmaceutical Assays; the Estimation of Impurities under Authorised Standards; Forensic Examinations for Poisons and Elementary Organic Analysis. By A. B. Prescott, Ph.D., M.D. New York: Van Nostrand.

This book naturally suggests a comparison with a work very similar in its scope, by Mr. A. H. Allen. Dr. Prescott has, however, the advantage that his work is entirely in the hands of the public, whilst Mr. Allen is still in arrears. We likewise prefer Dr. Prescott's alphabetical arrangement to the classification adopted by Mr. Allen, which does not as readily permit the reader to find instructions for the examination of any substance required.

Dr. Prescott, however, seems to devote relatively too much space to poisons and medicinal products, and too little to the organic substances used in the arts and manufactures. We find here schemes for recognising or identifying colouring-matters on the fibre, or in substance, but we find no instructions, *e.g.*, for the examination and valuation of commercial samples of annatto, archil paste and liquor, carmine, cochineal, the dye-woods and their extracts, lac-dye, lake colours, indigo and its extracts, &c. In like manner there are here instructions for detecting and estimating gum, resin, starch in plant-analysis. But the student will not here learn how to distinguish the various starches and gums from each other. Soaps do not appear to enter into the author's plan; neither do varnishes, alizarin oils (as distinguished from the time-honoured *huile tournante*), and, indeed, not a few other commercial substances. The use of the microscope in the recognition of animal and vegetable bodies is referred to merely under the alkaloids, and we find no mention of the use of the spectroscope in the identification of colouring-matters. Hence, whilst in certain departments this work is decidedly valuable, we cannot pronounce it complete.

A Treatise on Alcohol, with Tables of Spirit Gravities. By Thomas Stevenson, M.D. (Lond.), F.R.C.P. (Lond.), F.I.C., &c. Second Edition. London: Gurney and Jackson.

This little book is not a mere reprint of the earlier edition, as the whole has been re-written in consequence of the recent researches on absolute or "dry" alcohol conducted by Messrs. Squibb. It is, however, admitted that the law according to which alcohol and water contract, when mixed together, has not yet been ascertained. In the meantime all persons interested, from whatever point of view, are compelled to depend upon actual experiment for the determination of spirit gravities.

Messrs. Squibb appear to have been the first chemists who ever obtained a really absolute alcohol, a task requiring great nicety and care, especially as such alcohol greedily absorbs water from the atmosphere. Their product had, at 60° F., the specific gravity of 0·79350. At the same temperature Mendeleeff had found 0·79404, Dupré and Page, 0·79391, and Fownes 0·7938. The author considers the tables of Fownes less trustworthy than those of Blagden and Gilpin.

In his tables the author gives, in parallel columns, the specific gravity of a spirit at 60° F. Water at the same temperature being taken = 1, the percentages of actual alcohol respectively by weight and by volume, and the percentage of proof-spirit. The reason why this "survival" is still taken as the official standard is the trouble and expense of rejecting the instruments and tables at present in use.

The value of Dr. Stevenson's work to analysts requires no exposition.

Outlines of Qualitative Analysis. By G. W. Slatter, A.R.C.Sc., F.I.C., F.C.S. London: Thomas Murby.

This work, extending only to 140 pages, is of necessity brief. It is not, we are glad to find, put forward as being specially arranged for students "preparing" for some examination. At the outset we meet with some "useful hints" on analytical work which are really useful and appropriate. Next follows a list of the apparatus required in colleges and schools, for each pupil; a catalogue of the general and special reagents needed; after which the author proceeds to "preliminary operations."

In the body of the work we do not meet with anything calling for special remark. Diagrams of the apparatus required are not given,—a very judicious limitation, as their value is not proportionate to their cost and the space which they take up.

In the Preface the author admits that the directions given for manipulation are very brief, rightly remarking, however, that more good will be effected by showing a student how a thing is done than by giving him copious written directions. The student who is obliged to dispense with practical instruction will find chemical manipulation not free from difficulties, and will require a large fund of patience.

CORRESPONDENCE.

ON SOLUTION.

To the Editor of the Chemical News.

Sir,—Will you allow me to call attention to an article on "Solution," by Prof. Pickering, in the Chemical News (vol. lvi., p. 181), and which I overlooked until the other day. In that article Mr. Pickering favours me with criticism and advice. For the latter I am much obliged, but do not feel much the wiser, as I was not unaware of the various cautions he refers to. When anyone criticises equations he should pay attention to the signs used, as these are sometimes important. He gives my first equation as—

$$Mg,Cl_2 - Mg,O,Aq - (Ca,Cl_2 - Ca,O,Aq) = = MgCl_2,Aq - CaCl_2,Aq.$$

Now my equation correctly stated is—

$$Ca,Cl_2 - Ca,O,Aq - (Mg,Cl_2 - Mg,O,Aq) = = MgCl_2,Aq - CaCl_2,Aq.$$

This is very different, as it brings out the *inverse* nature of the problem, and if his other equations were correct, would bring out the conclusion that—

$$CaCl_2,Aq - MgCl_2,Aq = MgCl_2,Aq - CaCl_2,Aq,$$

or, in other words, that it does not matter whether you put the horse before the cart or the cart before the horse. I find, however, that he puts—

$$Mg,Cl_2 = 2(H,Cl,Aq) + R + N + MgCl_2,Aq.$$

This is not correct.

$$Mg,Cl_2 = 2(H,Cl,Aq) + R + N - MgCl_2,Aq.$$

The other instances given are of a precisely similar nature and need no further comment. Stated in this, the correct way, Mr. Pickering's results, instead of proving

my views to be wrong, go far to confirm and strengthen them, as they bring out the intimate and inverse relation between ordinary chemical affinity and solution, and further putting aside my equation altogether then—

$$\left\{\begin{matrix}Mg,Cl_2-\\Mg,O,Aq\end{matrix}\right\} = (2(H,Cl,Aq)+R+N-MgCl_2,Aq)- -(R+H_2O)=C.$$

It is evident the value of C depends positively on the excess of 2(H,Cl,Aq)+N over H_2O, and negatively on the value of ($MgCl_2$,Aq), so that if there were no solution the excess of the heats of formation of all dry chlorides over those of their oxides in water would be a constant quantity of about 38,000 units. Now when the heat of solution approaches the sum or goes beyond it we have decomposition, the chlorine going to the hydrogen of the water, and the metal to the oxygen, clearly showing what the action is. The atoms are, as it were, turned round as the balance is in favour of the latter arrangement. The heat of solution indicates their approach to this state. Mr. Pickering is acquainted with what happens when $MgCl_2$, Al_2Cl_6, or PCl_3 are put into water, and I have shown in a paper published in the *Proceedings of R. S. Ed.*, July 15, 1887, that this is a regular recurring phenomenon, that, in fact, solution passes into decomposition, and is a periodic function of the atomic weights of the elements like other chemical phenomena.

I have no cause to quarrel with Mr. Pickering's idea that hydrates are formed in solution; they may be, although I think not, but if they are formed this does not account for solution, for it may be asked what forms the hydrates? I maintain solution is due to the chemical affinity of the constituent atoms for one another, and that affinity is not all exhausted in ordinary combinations. I am glad to know that my views coincide in many respects with Mr. Pickering's own. This, I suppose, refers to residual affinity, which he claimed to have suggested simultaneously with Dr. Armstrong in 1885; but as I stated this view in 1878, and was rather laughed at in consequence, I may claim that they, as well as Helmholtz, who made the same suggestion some years later, have followed me, and perhaps, if Mr. Pickering lives long enough (which I trust he may) he may find that seven years hence his views, as well as the views of a good many others, coincide with mine so far, at any rate, as solution is concerned.—I am, &c.,

William Durham.

Portobello, April 19, 1888.

NEW ELEMENTS.

To the Editor of the Chemical News.

Sir,—I have just observed the letter of A. E., dated the 19th of April, and published in the Chemical News of April 27th.

I am quite convinced in my own mind as to the peculiarities of the bodies alluded to, both in regard to their equivalents and to their reactions, and as to their difference from the elements hitherto described. I have, however, scarcely as yet taken any further steps to bring them under public notice, because other engagements have for long prevented me from devoting time to chemistry.

I shall be very much pleased if A.E. will address to me any questions on the subject, or communicate with me in any way he chooses, with a view to satisfying himself as to whether or not he has been working with the same elements as I have. Perhaps he and I may be able to assist one another.

With this object I enclose my address.—I am, &c.,

Alex. Pringle.

Yair, Selkirk, May 1, 1888.

Royal Institution.—Prof. W. Chandler Roberts-Austen, F.R.S., will lecture on Friday evening, the 11th of May, in place of Mr W. H. Barlow, F.R.S. The lecture will be "On Some Curious Properties of Metals and Alloys."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 15, April 9, 1888.

The Fixation of Nitrogen by Certain Soils and Vegetable Moulds.—M. Berthelot.—In this paper the author criticises the experiments of M. Schlœsing, recently submitted to the Academy. He urges that even if the soil selected by M. Schlœsing was one of those which have the property of fixing atmospheric nitrogen, his experiments have involved a number of conditions which have been proved to be unfavourable to such fixation, such as the compactness of the soil, the presence of an excess of water, and the heating of the soil producing a current of steam in the mass. Each of these conditions, taken singly, would have sufficed to arrest the phenomenon, probably by destroying the vitality of the microbia which fix nitrogen.

Action of Carbon Tetrachloride upon Mineral Oxygen Compounds free from Hydrogen.—H. Quantin.—All oxygen compounds not containing hydrogen are attacked at varying temperatures by carbon tetrachloride; the non-metal and the metal which they contain pass into the state of oxychlorides whenever such compounds can exist in the conditions of the experiment in presence of an excess of carbon tetrachloride. The latter body itself is resolved into oxychloride and carbon dioxide. If the temperature is such that the oxychlorides formed are reduced, we obtain chlorides. The same results may be obtained by the action of a mixture of chlorine and carbon monoxide instead of the tetrachloride. These experiments show that carbon in gaseous combinations retains the reducing power which it has in the solid state.

On Rhodium Sesquichloride.—E. Ludié.—The author finds the action of chlorine upon heated rhodium is tedious and incomplete. He did not succeed in obtaining a chloride of constant composition. On heating rhodium sulphide in a current of chlorine the chlorine was not taken up as the sulphur was expelled. On heating the double rhodium alkali chlorides with excess of sulphuric acid and washing out the alkaline sulphate, there was formed, not, as Claus asserts, an insoluble rhodium sesquichloride, but a sparingly soluble sulphate mixed with alkaline sulphate. The author obtained the anhydrous sesquichloride by heating ammonium chloro-rhodate in a current of very dry nitrogen. The best process of preparing anhydrous rhodium sesquichloride is heating the alloy of rhodium and tin described by Debray in chlorine. The author has formed and examined certain double chlorides formed by hydrated rhodium sesquichloride with the alkaline chlorides.

The Passive State of Iron and Nickel.—E. Saint Edme.—The nickel of commerce immediately becomes passive if immersed in ordinary nitric acid. Iron, whilst being briskly attacked by common nitric acid, is rendered passive by contact with nickel. If steel and nickel are plunged into the acid together the former metal is not even momentarily attacked. Nickel retains energetically a proportion of combined nitrogen, to which its passivity is due.

Action of Zinc Cyanide upon Certain Chlorides.—M. Raoul Varet.—The author finds that zinc cyanide does not form molecular combinations with the chlorides.

Syntheses by Means of Cyanacetic Ether. Higher Homologues of Acetyl-cyanacetic Ether.—Alb. Haller.—This memoir does not admit of useful abstraction.

The Hydrocarbons accompanying Diterebenthyl in the Resin Oils.—Adolphe Renard.—The resin oils,

which represent almost 9-10ths of the products of the distillation of colophony, consist of a mixture of about 80 per cent of diterebenthyl, 10 per cent of diterebenthylene, and 10 of didecene.

Formation-Heat of Aniline.—P. Petit.—The author has examined this question by two methods, the results obtained being respectively −12·4 cals. and −13·0 cals.

The Volatility of the Polyoxygenated Carbon Compounds.—Louis Henry.—The simultaneous presence of several atoms of oxygen in the same region of a carbonised molecule has upon it a volatilising influence.

Combustion-heat of the Coal of the North of France.— M. Scheurer-Kestner.— Calculation does not lead to results which even approach the truth. The formula of Cornut departs least from reality, and that of Dulong most widely.

Researches on the Fixation of Nitrogen by the Soil and by Plants.—Arm. Gautier and R. Drouin.—The authors conclude from their experiments that monocellular algæ, and doubtless other aërobic beings, play a part in this fixation, as do doubtless the aërial parts of plants, and that whatever may be the initial state of this nitrogen, it passes into the organic state as well in the soil as in the plant.

Researches on Phosphorescent Hexagonal Blende.—A. Verneuil.—Not adapted for useful abstraction.

No. 16, April 16, 1888.

The Spectra of Oxygen.—J. Jansen. — The author has observed a fact which furnishes a remarkable demonstration of the law of the production of the dark bands which he has detected in the spectrum of oxygen. The phenomena of elective absorption in oxygen gas are manifested in two mutually distinct spectral systems. A first system, formed of fine rays, follows the law of the product of the gaseous system traversed by its density. The second system is formed of bands much less easily resolved, is governed by the law of the product of the thickness by the square of the density. This second law being quite novel in spectral analysis, the author has instituted experiments necessary to prove that this system of obscure bands really belongs to oxygen. These experiments range from pressures of 100 atmospheres down to those of a few units, and with lengths of tubes from 0·42 metre to 60 metres. At the same time prolonged observations have been made upon the atmosphere, brought into connection with the experiments in the tubes. These observations, and especially those made during autumn last on the Pic du Midi, prove that all the bands of the spectrum of oxygen are found in the spectrum of the solar light if it is allowed to traverse a sufficient thickness of the atmospheric medium. Further, on comparing, by the aid of photography, the intensities of the bands of the atmospheric spectrum with those given in the tubes, the author has found that the intensities of these atmospheric bands fulfil the law of the square. It appears from *Wiedemann's Annalen* that M. Olszewski, when liquefying oxygen, examined its spectrum and ascertained the existence of the bands in question with a stratum of 7 m.m. of liquid oxygen.

Relations of Atmospheric Nitrogen to Vegetable Soil. Reply to the Observations of M. Berthelot, inserted in the "Comptes Rendus" of April 9th.—Th. Schlœsing.—The writer maintains that Boussingault did not consider the vegetable soil as an inert and lifeless mass. M. Berthelot's critique on M. Schlœsing's own experiments is without foundation. Lastly, the writer does not deny the possibility of the fixation of atmospheric nitrogen in vegetable soil, but merely says that it is not proved by his experiments, nor by those of M. Berthelot.

Contribution to the Study of Cast-Irons. — F. Osmond.—The author's results show that the cast-irons of commerce are highly complex mixtures of different compounds or alloys.

On a Sodium-potassium Carbonate. — MM. Hugounenq and Morel. — Sodium and potassium carbonates can crystallise together, yielding isomorphous mixtures which cannot be represented by formulæ, as they may vary indefinitely.

Combustion-heat of the Coal of the North of France.—M. Scheurer-Kestner.—The author's results are given in a tabular form.

Thermo-chemistry of the Diazo-compounds.—Leo Vignon.—Like most thermo-chemical memoirs this paper does not admit of useful abstraction.

Volatility in Poly-oxygenated Carbon Compounds.—Louis Henry.—The volatilising influence is at its maximum when the two atoms of oxygen, the presence of which is its origin, are in the closest proximity. The influence is still powerful, though less energetic, when the two atoms of oxygen are fixed upon atoms of carbon distinct but adjacent. It is more feebly exerted when the atoms of oxygen are fixed upon atoms of carbon not immediately united. All volatilising influence ceases when the two atoms of oxygen are fixed upon atoms of carbon separated by the interposition of other atoms of carbon.

On Cyanaldehyd.—P. Chautard.—This compound, isomeric with acetyl cyanide, is a colourless limpid liquid, highly refringent, miscible with water without decomposition, soluble in all proportions in alcohol, ether, chloroform, and acetone. It is very volatile and inflammable, boils at 71·5°, and does not solidify at −20°. Its specific gravity is 0·881.

Action of Acids and Anhydrides upon the Terpilenols.—J. Lafont.—The terpilenols may be transformed into ethers, either by acetic anhydride or by formic and acetic acids. In this latter case the etherification is slow.

Synthesis by Means of Cyanacetic Ethers. III. Benzol, Ortho-toluol and Para-toluol-acetic Ethers.—Alb. Haller.—Not adapted for useful abstraction.

Researches on the Fixation of Nitrogen by the Soil and Plants.—MM. Gautier and Drouin.—A. Nitrogen of soils not planted. Here there was a disappearance of ammoniacal nitrogen, part of which had passed into the state of organic nitrogen. B. Nitrogen of planted soils. Here also there ensues a constant decrease of ammoniacal nitrogen and an increase of organic nitrogen.

The Biological Function of the Cholesteric Ethers named Lanoline.—Oscar Liebreich.—The author shows that lanoline is not peculiar to the wool of sheep, but exists in hair, scales, whalebone, the horns of ruminants, the spikes of the porcupine, the hoofs of horses, &c. It plays the same part on the surface of animals as does wax on the surface of plants. It is not readily saponified by caustic alkalies, and resists the attacks of microbia.

———

Moniteur Scientifique, Quesneville.
Series 4, Vol. ii., February, 1888.

The Causes of the Deterioration of Leaden Water Pipes.—Max Müller.—From the *Journal fur Praktische Chemie*.

Study on the Emulsive Oils and on a New Method of Examining Fatty Bodies.—R. Benedikt and F. Ulzer.—The method in question will be inserted at some length.

The Manufacture of Alpha-naphthylamine.— Dr. O. N. Witt.—This extensive memoir does not admit of useful abstraction.

The Formation of the Hyponitrites. — Messrs. Wyndham R. Dunstan and T. S. Dymond. — From the *Journal of the Chemical Society*.

Researches on the Ferric Hydrates.—Dr. Donato Tomasi.—The ferric hydrates may be divided into two isomeric series, the red, α, and the yellow, β. The former hydrates are obtained whenever a ferric salt is precipitated

by potassa, soda, or ammonia, or by the corresponding carbonates. Their reddish brown colour is universally known. The weakest acids dissolve them readily, and they are also soluble in ferric chloride, with which they form oxychlorides. They are easily dehydrated on boiling in water. On ignition they yield a black oxide. If dried at 35° to 40° they yield a dihydrate, and a monohydrate if dried at 90°. They occur in two modifications, soluble and insoluble, which are unstable and return to their original type, either on standing or under the influence of heat. The hydrates of the series β are obtained by the oxidation of the ferrous hydrate or carbonate or of the magnetic hydrate. On ignition they yield an oxide which varies in tone from a bright red to the yellow of burnt sienna. They are more stable than series α, never becoming anhydrous on prolonged boiling in water. If boiled in a strong solution of calcium chloride they still retain 1 mol. of water. They may be converted into the α-series by solution in hydrochloric acid and re-precipitation with ammonia. They do not combine with ferric chloride to form oxychlorides.

Researches on the Azimuths of Polarisation of Convergent Light on Emerging from Uniaxial Birefringent Laminæ.—Dr. G. Quesneville.—A mathematical paper, not susceptible of useful abstraction.

Contribution to the Knowledge of the Quinquina Alkaloids.—O. Hesse.—From *Liebig's Annalen.*

Chemical Composition of Howlite and Notes on Gooch's Method for the Determination of Boric Acid.—S. Penfield and E. Spierry.—From the *American Journal of Science.*

Action of Sea-Water upon Cast-Iron. — Carter Napier Draper.—From the CHEMICAL NEWS.

MEETINGS FOR THE WEEK.

MONDAY, 7th.—Medical, 8.30. (Annual Oration).
—— Society of Arts, 8. "Decoration," by G. Aitchison, A.R.A.
—— Royal Institution, 5. General Monthly Meeting.
TUESDAY, 8th.—Royal Medical and Chirurgical, 8.30.
—— Institution of Civil Engineers, 8.
—— Photographic, 8.
—— Society of Arts, 8. "The Decorative Use of Colour," by J. D. Crace.
—— Royal Institution, 3. "The Plant in the War of Nature," by Walter Gardiner. M.A.
WEDNESDAY, 9th.—Geological, 8.
—— Microscopical, 8.
—— Society of Arts, 8. "Locks and Safes," by Samuel Chatwood.
THURSDAY, 10th.—Mathematical, 8.
—— Telegraph Engineers, 8.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.
—— Society of Arts, 2. Conference on Canals and Inland Navigation.
FRIDAY, 11th.—Quekett Club, 8.
—— Astronomical, 8.
—— Society of Arts, 2. Conference on Canals and Inland Navigation.
—— Royal Institution, 9. "Some Curious Properties of Metals and Alloys," by Chandler Roberts-Austen, F.R.S.
SATURDAY, 12th.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.
—— Society of Arts, 11. Conference on Canals and Inland Navigation."
—— Physical, 3. "Note of the Condition of Self-excitement in a Dynamo Machine," and "Note on the Conditions of Self-regulation in a Constant Potential Dynamo Machine," by Prof. S. P. Thompson. "Note on the Electrical Action of Light," by Mrs. W. E. Ayrton. "On the Theory and Practice of Applying the Dynamometer to the Investigation of Transformers," by T. H. Blakesley. "On Measuring the Electromotion Force of Dynamos and Motors," by Prof. W. E. Ayrton, F.R.S., and Prof. J. Perry, F.R.S.

ERRATUM.—In the paper on "The Compounds of Ammonia with Selenium Dioxide," at p. 163, *for* "selenosomic acid," *read* "selenosamic acid,"

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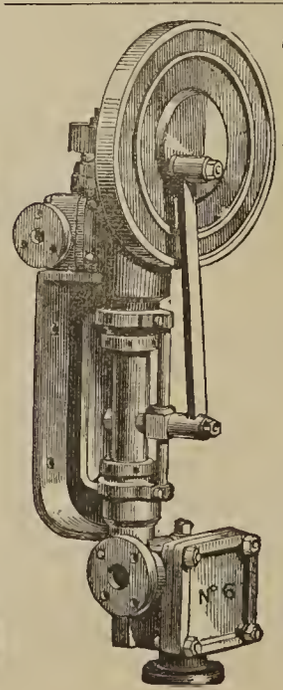

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IODIDE OF STARCH.

By H. B. STOCKS.

As all the experiments I had hitherto tried on iodide of starch (Chemical News, vol. lvi., p. 212) were done in the presence of water, or the liquid containing other products besides iodide of starch, which had been used in its formation, such as excess of iodine, or starch, &c., it seemed advisable to try the action of heat on dry iodide of starch, and for this purpose I prepared pure iodide of starch by adding iodine solution to starch paste in water; on adding alcohol, all the iodide of starch was thrown out of solution, it was filtered off, and dried carefully. The substance thus prepared was a black shining mass.

Some of this iodide of starch was heated for six or seven days at 100° C. without any odour of iodine being perceptible, and without its colour being destroyed. This was rather remarkable, because if heated in contact with water it would have very soon lost all its colour.

Another portion of this dry iodide was heated in a tube to a higher temperature than the above; it did not give off any iodine, nor change colour, until tarry matters began to come off; iodine vapour was then noticed in the tube along with the products of destructive distillation.

Iodide of starch is therefore a stable body, not acted upon by heat alone, up to at least 100° C., but in contact with water it is decomposed with formation of hydriodic acid in closed vessels, in open vessels with volatilisation of part of the iodine, the remainder being converted into hydriodic acid.

Iodide of starch, when dry, is not acted upon by sunlight.

On treating dry iodide of starch with water it did not dissolve, and required long boiling before it was decomposed; after decomposition, starch and a trace of hydriodic acid were found in the liquid.

Following up the experiments on the action of silver nitrate on iodide of starch, I divided the product into two portions, *i.e.*, precipitate and filtrate, and tried the action of each of these on a mixture of potassium iodide and starch paste, and found that the precipitate had no action, but that the filtrate immediately produced a blue colour; it is therefore evident that the substance which liberates iodine is in the filtrate.

The substance liberated is either nitrous or nitric acid, but as I could only find nitrous acid I conclude the equation is—

$$2AgNO_3+2I+H_2O=AgI+AgIO_3+2HNO_2.$$

This equation represents only the action of silver nitrate on the iodine, the starch undergoing no change.

I next tried the action of silver sulphate in place of silver nitrate, to see if it was nitrous acid that produced the blue colour, but was surprised to find that the blue appeared as with silver nitrate.

Looking up these reactions, I could only find mention of them by Fresenius, who says that when silver nitrate acts upon iodide of starch, silver iodide and hypoiodite (iodate) of silver are formed and gives—

$$I_6+6AgO,NO_5=AgO,IO_5+5AgI.$$

This would really require $3H_2O$, and HNO_3 would be formed thus—

$$I_6+6AgNO_3+3H_2O=AgIO_3+5AgI+6HNO_3.$$

As a preliminary experiment silver nitrate was precipitated by excess of iodine, and the precipitate washed from any soluble matter; this precipitate, added to a mixture of starch paste and potassium iodide, gave no blue, but on addition of dilute sulphuric acid, gave an immediate blue colour.

Dilute sulphuric acid, added to a mixture of starch paste and potassium iodide, did not become blue until it had stood some time, and this, of course, was due to decomposition of potassium iodide by the sulphuric acid.

Silver sulphate was precipitated by iodine and the precipitate washed from soluble matter; this precipitate, added to starch paste, produced no blue; with dilute sulphuric acid still no blue; potassium iodide added to this produced an immediate blue colour.

Silver iodate was next tried; when mixed with starch paste and potassium iodide and dilute sulphuric acid added, an immediate blue colour was formed.

The experiments above quoted serve to show the action of silver sulphate on iodide of starch, the action, of course, being on the iodine. The first change is the formation of silver iodate and silver iodide, represented by the following equation—

$$3Ag_2SO_4+6I+3H_2O=5AgI+AgIO_3+3H_2SO_4,$$

but there is some action between the sulphuric acid liberated and silver iodate, and, as a result, iodic acid passes into solution, and this acting upon potassium iodide liberates iodine, which combines with the starch forming the blue colour, the reaction being—

$$HIO_3+5HI=6I+3H_2O.$$

A soluble iodide or hydriodic acid is necessary to this reaction, as silver iodide is not acted upon under these circumstances.

It will be seen from my former paper what bearing these experiments have on the conjectures of Mylius, that hydriodic acid is necessary to the formation of iodide of starch, as on looking at these experiments we should see that they prove just the contrary to what he affirms, and also prove that it is free iodine and not hydriodic acid and iodine together that produce the blue colour, besides giving us an insight into the action of free iodine on silver salts.

With regard to the blue colour of iodide of starch, Pohl states that with the different starches the colour is not the same, but I found it to be the same in all cases when the same quantities of iodine and of starch were used in each case. A small quantity of iodine gave an indigo blue with more iodine violet, and when the iodine was in excess it appeared green, but the iodide of starch which was precipitated by the excess of iodine was quite blue.

The blue colour of iodide of starch is destroyed by potassium permanganate, with, after some time, deposition of oxide of manganese. In this case the starch is destroyed.

Iron filings destroy the blue colour, but zinc and sulphuric acid did not destroy it.

When bromine water is added to a solution of iodide of starch the blue is destroyed; large excess of starch does not re-form the blue colour, but on carefully neutralising with sodium carbonate all the bromine may be neutralised; the iodine is thus liberated and the blue colour again formed. It is evident that the reason why bromine destroys the combination is the formation of bromide of iodine as before stated.

Potassium bichromate precipitates the blue compound, but does not destroy it.*

Iodide of starch heated with alcohol is rapidly decolourised, even at a moderate temperature, with formation of ethyl iodide. On boiling the solution the latter is volatilised.

Since writing my last paper M. Hönig and S. Schubert have published a paper on lichenin (*Monatsh.*, viii., pp. 452 to 465; and *Journal Chem. Soc.*, cccii., p. 127), in which they prove that lichenin is not coloured blue by iodine, but that the blue is due to a starch existing in the moss, which they have named lichen starch.

* *Erratum in Former Paper.*—Potassium bichromate, when added to a solution of potassium iodide and starch, did not produce a blue colour, but on addition of dilute sulphuric acid the blue was formed.

The blue colour that iodine gives with starches is therefore very characteristic, as it is not formed, as I am aware of, with any other body.

THE ELECTRO-CRYSTALLISATION OF METALLIC COPPER.

By H. N. WARREN, Research Analyst.

The apparatus made use of for the above-mentioned substance consists entirely of an open tube, closed at one extremity by means of a bladder diaphragm, and suspended in a solution of dilute sodium chloride. Into the tube is introduced a saturated solution of cupric sulphate, the strength of the solution being maintained by the insertion of a smaller tube terminating in a point, and containing crystals of $CuSO_4$. A strip of copper-foil, about 3 inches long by 1 inch wide, is next introduced into the copper solution, and connected by means of a copper-wire to a plate of zinc, forming the negative electrode and in contact with the salt solution. After the lapse of a few hours small cubical crystals of metallic copper gradually begin to appear on the copper electrode, which in the course of a week or more will have arranged themselves into a compact crystalline mass, possessing a full metallic lustre, and rivalling in purity and malleability the finest specimens of native copper, which they much resemble. Metallic silver, antimony, bismuth, zinc, and even aluminium, magnesium, iron, chromium, and all the more oxidisable metals, may by slight alterations be reduced to the metallic state.

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18, Albion Street, Everton, Liverpool.

EFFECT OF CHLORINE ON THE ELECTROMOTIVE FORCE OF A VOLTAIC COUPLE.*

By Dr. G. GORE, F.R.S.

If the electromotive force of a small voltaic couple of unamalgamated magnesium and platinum in distilled water is balanced through the coil of a moderately sensitive galvanometer of about 100 ohms resistance, by means of that of a small Daniell's plus that of a sufficient number of couples of iron and German silver of a suitable thermo-electric pile (see *Proc. Birmingham Philos. Soc.*, vol. iv., p. 130), the degree of potential being noted, and sufficiently minute quantities of very dilute chlorine water are then added in succession to the distilled water, the degree of electromotive force of the couple is not affected until a certain definite proportion of chlorine has been added; the potential then suddenly commences to increase, and continues to do so with each further addition within a certain limit. Instead of making the experiment by adding chlorine water, it may be made by gradually diluting a very weak aqueous solution of chlorine.

The minimum proportion of chlorine necessary to cause this sudden change of electromotive force is extremely small; in my experiments it has been 1 part in 17,000 million parts of water,† or less than 1-7000th part of that required to yield a barely perceptible opacity in ten times the bulk of a solution of sal-ammoniac by means of nitrate of silver. The quantity of liquid required for acting upon the couple is small, and it would be easy to detect the effect of the above proportion, or of less than 1-10,000 millionth part of a grain of chlorine in one tenth of a cubic centimetre of distilled water by this process. The same kind of action occurs with other electrolytes, but requires larger proportions of dissolved substance.

As the degree of sensitiveness of the method appears extreme, I add the following remarks:—

The original solution of washed chlorine in distilled water was prepared in a dark place by the usual method from hydrochloric acid and manganic oxide, and was kept in an opaque well-stoppered bottle in the dark. The strength of this liquid was found by means of volumetric analysis with a standard solution of argentic nitrate in the usual manner, the accuracy of the silver solution being proved by means of a known weight of pure chloride of sodium. The chlorine liquid contained 2·3 m.grms., or 0·03565 grain of chlorine per c.c., and was just about three-fourths saturated.

One-tenth of a c.c. of this solution (No. 1) or 0·003565 grain of chlorine was added to 9·9 c.c. of distilled water and mixed. 1 c.c. of this second liquid (No. 2) or 0·0003565 grain of chlorine, was added to 99 c.c. of water and mixed; the resulting liquid (No. 3) contained 0·000003565 grain of chlorine per c.c. To make the solutions (No. 4) for exciting the voltaic couple, successive portions of 1-10th or 1-20th c.c. of No. 3 liquid were added to 900 c.c. of distilled water and mixed.

I have employed the foregoing method for examining the states and degrees of combination of dissolved substances in electrolytes, and am also investigating its various relations.

* A Paper read before the Royal Society, May 3rd, 1888.

† As 1 part of chlorine in 17,612 million parts of water had no visible effect, and 1 part in 17,800 millions had a distinct effect, the influence of the difference, or of 1 part in 500,000 millions, has been detected.

RESEARCHES ON ALLOISOMERISM.*

I.

By ARTHUR MICHAEL.

There is scarcely a subject in organic chemistry that has attracted more attention and has been more fully investigated than the isomerism of maleic and fumaric, and citra-, ita-, and mesaconic acids. The interest shown in the examination of these acids has been largely due to the difficulty that the present theories of structural chemistry find in giving a satisfactory explanation of their constitution. Kekulé,† whose brilliant investigation of these acids may be considered as forming the corner-stone of our knowledge of their structure, made an attempt at an explanation, but it can hardly be considered as throwing much light on the subject. It was next considered by H. Kolbe, who in this, as in all other questions relating to isomerism and constitution of organic compounds, showed the keenest insight of any chemist of his time. Kolbe gave maleic and fumaric acids substantially the constitutions at present generally adopted.‡ Somewhat later, Kekulé§ returned to the subject, and assigned analogous constitutions to the methyl homologues:—

$CH_2—COOH$	$CH_2—COOH$	$CH_2—COOH$
|	|	|
C	CH_2	CH
|	|	|
$CH_2—COOH.$	$=C—COOH.$	$CH—COOH.$
Itaconic acid.	Citraconic acid.	Mesaconic acid.

The formulæ of the first two acids were changed by Meilly,‖ in accordance with a better knowledge of the constitution of pyrotartaric acid, to the following:—

* *American Chemical Journal*, Vol ix., No. 3.

† *Annalen der Chemie*, Suppl., ii., 114.

‡ *Lehrbuch*, 1ste Aufl., ii., 579. Changed in accordance with the present notation, they are represented by—

$$\begin{matrix} CH_2—COOH \\ | \\ C \quad —COOH \end{matrix} \quad \text{and} \quad \begin{matrix} CH—COOH \\ \| \\ CH—COOH. \end{matrix}$$

§ *Zeitschrift fur Chemie*, N. F., iii., 652.

‖ *Annalen der Chemie*, clxxi., 153.

$$\begin{array}{ll} CH_2 & CH_3 \\ \| & | \\ C—COOH & C—COOH \\ | & \| \\ CH_2—COOH. & CH—COOH. \end{array}$$

To explain the isomerism of mesaconic acid, Henry* and Markownikoff† supposed it to be a polymeride of citraconic acid; a view, as Fittig has remarked, that can hardly be upheld, as Hübner and Schreiber‡ had shown that the evidently analogously constituted fumaric and maleic acids have the same molecular weight. Van't Hoff § deserves the credit of considering the subject from a new point of view. In his pamphlet on the constitution of organic substances he concluded that the isomerism of maleic and fumaric, and of citraconic and mesaconic, acids cannot be represented by the present views on the molecular constitution of organic compounds, and attempted to show that it may be explained by his ingenious hypothesis concerning the configuration of the molecule in space. This chemist suggested that several other knotty problems of organic chemistry may be explained in the same manner; as the constitution of the two β-chlorcrotonic and bromcinnamic acids, as well as those of angelic and tiglinic acids. It is perhaps because Van't Hoff made no experimental contribution to the question, and the adopted structural theories permitted what seemed to most chemists a more plausible explanation of these cases of isomerism than that proposed by him, that his views were not adopted. The question was then made by Fittig‖ and his pupils the subject of an elaborate series of investigations. Fittig revived the formulæ of fumaric and maleic acids suggested by Kolbe, and believed that his work confirmed them. He followed a suggestion previously made by Kekulé, which is, that compounds containing a bivalent carbon should form addition products with more readiness than those containing so-called doubly-linked carbons. He showed that Kekulé's previous observation of the greater facility with which maleic and citraconic acids go over into saturated compounds than their isomerides is true in other reactions. These views seem to have been adopted by the majority of chemists, although it was known that a great many organic compounds containing so-called double bonds form addition products with equal facility; indeed Anschütz¶ has shown that fumaric ether takes up bromine with as great readiness as any maleic compound; and they are evidently based on that curious dogma of double bonds of the existence of which there is not a tittle of satisfactory proof. Finally, as to the latest contributions on the subject, I refer to Kekulé and Anschütz's** hypothesis that fumaric acid consists of a right- and left-handed optically active maleic acid; to Le Bel's†† geometrical formulæ; to Erlenmeyer's‡‡ chemical explanation; and to a brief discussion of these and other views on the subject by the writer.§§

It seemed as if contributions to our knowledge of this intricate case of isomerism might be made in two directions. In the first place, a more exact and general method of distinguishing between acids belonging to the fumaric and maleic series was desirable. The present means of distinction, which rests on the capability of the acid of forming an anhydride, means that the operation must be performed at a temperature where intramolecular changes are not unlikely to occur, that a comparatively large amount of the acid must be used, and it is not applicable to a large number of unsaturated acids, the classification of which would doubtless throw light on the constitution of the already classified acids; secondly, an examination of such unsaturated halogen acids as the so-called β-chlor- and β-isochlorcrotonic, and α- and β-bromcinnamic acids, with a view of bringing indisputable proofs in regard to their constitutions. The present views on the constitution of organic compounds seem to many chemists to represent a state of finality, instead of being only a guide to a better insight; and this is probably the reason why the constitution of so many compounds is accepted without any further proof, simply because their existence is indicated by the present hypotheses. In no part of organic chemistry is this more noticeable than among unsaturated acids and their halogen derivatives, where the constitution of many compounds has been assigned in apparent contradiction to all analogy, simply that their existence may be explained by the present views on chemical isomerism.

A clue to a general method of distinguishing between acids of the fumaric and maleic series was found in an observation made by Gottlieb,* that an aqueous solution of the aniline salt of citraconic acid gives citraconanil on boiling, while a solution of the isomeric aniline mesaconate can be evaporated to dryness without undergoing a change. On following this line of investigation it was found than the distinction is general between acids of the fumaric and maleic series, and the results obtained form the subject of the following communications.

I. A Relation between the Constitution of Polybasic Unsaturated Organic Acids, and the Formation of their Anilides.

By Arthur Michael.

Behaviour of Maleic Acid towards Aniline.

To a solution of 8 grms. of maleic anhydride (1 mol.) in 100 grms. of water, 7·4 grms. of aniline (1 mol.) were added. The aniline went immediately into solution, which was then heated in a water-bath, when presently needles began to separate. After heating for an hour the contents of the flask were allowed to cool, filtered, and the filtrate heated again, when it gave a further deposit of needles on cooling. The substance was purified by several crystallisations from alcohol, and gave on analysis the following result:—

0·2314 grm. substance gave 0·6115 grm. CO_2 and 0·1145 grm. H_2O.

	Theory for $\begin{matrix} CH—CONHC_6H_5 \\ \| \\ CH—CONHC_6H_5 \end{matrix}$.	Found.
C	72·18	72·07
H	5·26	5·49

The anilide crystallises from alcohol in long white needles that melt at 211° to 212°. It is somewhat soluble in hot, sparingly in cold, water; readily in hot, pretty soluble in cold, alcohol. It is insoluble in dilute mineral acids and alkalies. The formation of the anilide may be represented as follows:—

$$\begin{matrix} CH—COONH_3C_6H_5 \\ | \\ CH—COONH_3C_6H_5 \end{matrix} = \begin{matrix} CH—CONHC_6H_5 \\ | \\ CH—CONHC_6H_5 \end{matrix} + 2H_2O.$$

Besides the dianilide of maleic acid, a second substance, which remains in the alcoholic mother-liquor, is formed in the reaction. This compound is insoluble in dilute acids and alkalies, and may represent the anil.† ‡

* *Bull. Soc. Chim.*, xxiii., 347.
† *Annalen der Chemie*, clxxxii., 353.
‡ *Zeitschrift fur Chemie*, N. F., vii., 712.
§ "La Chimie dans l'Espace."
‖ *Annalen der Chemie*, clxxxviii., 95; cxcv., 128, 169; cc., 87.
¶ *Berichte der Deutschen Chemischen Gesellschaft*, xiii., 1541.
** *Berichte*, xiv., 717; xviii., 1400.
†† *Bull. Soc. Chim.*, xxxvii., 300.
‡‡ *Berichte der Deutschen Chemischen Gesellschaft*, xix., 1937.
§§ *Ibid.*, xix., 1381; xx., 554.

* *Annalen der Chemie*, lxxvii., 277.
† I have lately noticed that W. H. Perkin observed the formation of anilides from aqueous aniline maleate about six years ago (*Berichte*. xiv., 2540), and also that aniline fumarate remains unchanged. He made no analyses, and did not follow up the experiments.
‡ This paper, including the note referring to Perkin's observations, was in the hands of the printer when I received a paper by Anschütz and Wirtz (*Annalen der Chemie*, ccxxxix., 137) on the anilides of fumaric and maleic acids. These chemists have made a detailed

Behaviour of Fumaric Acid towards Aniline.

A dilute aqueous solution containing fumaric acid and aniline, in proportion to form the acid aniline salt, was heated for several days in a flask connected with an upright cooler. No precipitate was formed under these conditions, neither did anything separate from the solution on cooling. It contained unchanged aniline fumarate, and gave a precipitate of fumaric acid on addition of chlorhydric acid. This experiment was repeated with the same result with a concentrated solution of the salt, as well as when aniline in proportion to form the neutral aniline salt was used. If an aqueous solution of acid aniline fumarate is concentrated in an evaporating dish, it will be noticed that towards the end of the operation a precipitate is deposited. This consists of fumaric acid, as both the acid and neutral aniline salts of fumaric acid, when boiled with water, gradually decompose into acid and free base, the latter passing off with the steam.

Behaviour of Monobrommaleic Acid towards Aniline.

Monobrommaleic acid (obtained from dibromsuccinic acid by boiling with water, and melting at 128°) was dissolved in about 7 parts of water, and an equivalent quantity of aniline added. The base dissolved, and presently a crystalline precipitate separated. This consisted of clusters of plates, melting at 128° to 128½°, soluble in dilute chlorhydric acid. They are the acid aniline salt.

0·2592 grm. salt gave 0·1665 grm. AgBr.

	Theory for $\begin{matrix}CBr—COONH_3C_6H_5*\\ \vert\\ CH—COOH.\end{matrix}$	Found.
Br	27·75	27·30

If this acid salt is dissolved in water, and the solution allowed to stand several days at ordinary temperature, it will be noticed that a crystalline substance gradually separates.

0·2472 grm. gave 0·1708 grm. AgBr.

	Theory for $\begin{matrix}CBr—CONHC_6H_5\\ \vert\\ CH—COOH.\end{matrix}$	Found.
Br	29·63	29·36

The compound is the acid anilide of brommaleic acid, and crystallises in prisms. It is insoluble in dilute chlorhydric acid.

The action of aniline on brommaleic acid in the heat gives entirely different results from those obtained by allowing the reaction to proceed in the cold. The solution, on boiling, soon turns yellow, and a crystalline substance begins to separate. This substance is best made by heating a solution of the neutral aniline salt in about 30 parts of water, in a flask connected with an upright condenser, to boiling for about twenty minutes, and filtering the liquid while hot. The yellow precipitate was purified by several crystallisations from alcohol, and was found to be free of bromine.

0·2055 grm. substance, dried at 100°, gave 0·5513 grm. CO_2 and 0·0839 grm. H_2O.

	Theory for $C_{16}H_{12}N_2O_2$.	Found.
C	72·73	73·10
H	4·55	4·62

The substance crystallises from alcohol as ochre-coloured, round clusters of microscopic needles that melt at 229° to 230°. It is moderately soluble in hot, sparingly in cold, water; in hot alcohol it is pretty soluble, less in cold. The substance is insoluble in dilute acids and alkalies, but on standing with dilute solutions of the last reagent it very slowly goes into solution, to form the salt of a different substance, which is precipitated on addition of acids,—a result that takes place much more rapidly if warm alkali is used.

The aqueous filtrate from the yellow needles deposits a second substance, mixed with some of the first, on cooling. To separate these substances they may be crystallised from a small amount of water, filtering off the insoluble portion. It is easier, however, to treat the mixture with a very dilute solution of caustic alkali, which dissolves the new substance, leaving the yellow needles behind. The filtrate was carefully neutralised, and the precipitate purified by crystallisation from alcohol. It does not contain bromine.

0·2153 grm. substance, dried at 100°, gave 0·5389 grm. CO_2 and 0·102 grm. H_2O.

	Theory for $C_{16}H_{14}N_2O_3$.	Found.
C	68·09	68·23
H	4·96	5·27

The substance separates from water as very slightly yellow-coloured, round groups of indistinct small crystals that melt at 176°. It is quite soluble in hot, moderately in cold, water. Alkalies dissolve it immediately, and the addition of an acid causes a precipitate of the unchanged substance.

These substances stand in a simple relation to phenyl-amido-maleic acid, a substance that may be supposed to be the first product of the action of aniline on brommaleic acid in the heat:—

$$\begin{matrix}CBr—COONH_3C_6H_5\\ \vert\\ CH—COONH_3C_6H_5\end{matrix} = \begin{matrix}CNHC_6H_5—COOH\\ \vert\\ CH—COOH\end{matrix} + C_6H_5NH_3Br.$$

This acid unites with aniline to form a salt, and, being under conditions that make the existence of an aniline salt of a derivative of maleic acid impossible, a condensation takes place:—

investigation of the substance designated as the dianilide of maleic acid, and find that it gives phenylaspartic acid when treated with acids or alkalies. In view of these observations they change the constitution of the anilide to that of the isomeric anil of phenylaspartic acid. The constitution I assigned to the compound was the only one that could be given it at the time of the experiment. I take this opportun ty to explain the mistakes that led Mr. Wing and myself (*Amer. Chem. Journ.*, vii., 282) to give the constitution of a fumaric dianilde to the anil of maleic acid. A nitrogen estimation (owing to an erratum 0·1484 grm. of substance was printed instead of 0·1984 grm.) gave 10·19 per cent, a result that agrees fairly well with the amount indicated by theory. A carbon and hydrogen analysis gave 69·24 C and 4·30 H. This analysis was rejected, as everything seemed to point to the impossibility of the substance being an anil. It gave fumaric acid on continued boiling with water, and as there was no ground for supposing the existence of an anil of fumaric acid, the only explanation would have been the conversion of a maleic derivative into fumaric acid by heating with water, which seems very improbable. In the second analysis Mr. Wing made the mistake of adding the increase of weight of the solid caustic potash twice, and thereby got results that agreed with those indicated by the dianilide. Anschütz and Wirtz seem to have overlooked our statement that the compound is decomposed by continued boiling with water into fumaric acid and aniline. and give the existence of the supposed dianilide of maleic acid as a reason for our believing the compound to be an anilide of fumaric acid; but, as the empirical constitution of the maleic derivative was unknown at the time, it is not likely that this could have entered into our calculations. Perkin's observation on the formation of the anil of phenylaspartic acid differs from mine, as he heated the dry product to 100°, while I have made a point of showing the anilide formation in the presence of water in my experiments. The fact that an anilide is not formed from aniline mesaconate had already been noticed by Gottlieb, and the formation of citraconanil from a cold solution of aniline citraconate would seem, judging from the observations mentioned in the following paper, to be a mistake. As already stated, Perkin made no analyses, nor did he follow up his observations, and his opinion in regard to the constitution of the maleic acid derivative was based solely on the fact that aniline citraconate under the same conditions gives citraconanil. In view of this it is not a little surprising that Anschütz and Wirtz should endeavour to convey the impression that the views of Perkin and myself on the constitution of the substance conflicted. It would seem as if advantage was taken of circumstances to convey to the reader what seems to me to be almost a misrepresentation of the actual state of affairs.

* In this, and in a number of other constitutions, it is assumed that the base will unite with the carboxyl of the acid that is most under the influence of negative radicals.

$$CNHC_6H_5—COOH \mid CH—COONH_3C_6H_5 =$$

$$CNHC_6H_5—COOH \mid CH—CONHC_6H_5 \quad (C_{16}H_{14}N_2O_3)+H_2O;$$

$$CNHC_6H_5—COOH \mid CH—CONHC_6H_5 =$$

$$CNHC_6H_5—CO \mid CH — CO \rangle NC_6H_5. \quad (C_{16}H_{12}N_2O_2)+H_2O$$

The bright yellow substance, according to this interpretation, is the anil of phenyl-amido-maleic acid, and the pale yellow compound an acid anilide of the same acid.*

Behaviour of Bromfumaric Acid towards Aniline.

Monobromfumaric acid (melting-point 177° to 178°, made by heating dibromsuccinic acid and water to 150° in a sealed tube, and also by treating brommaleic with fuming bromhydric acid) and aniline in equivalent proportions unite immediately to form the acid aniline salt. This salt is quite insoluble in water, much more so than the corresponding brommaleic acid salt, and by adding aniline to a solution of 1 part of acid in 30 parts of water a copious precipitate soon separates. For analysis it was crystallised from water. It melts at 153° to 154°, and is soluble in dilute chlorhydric acid.

0·2697 grm. salt gave 0·1750 grm. AgBr.

	Theory for $CBr—COONH_3C_6H_5 \mid CH—COOH$.	Found.
Br	27 75	27·53

This salt shows a much greater stability than the corresponding brommaleic derivative. It may be allowed to stand with water for weeks without undergoing a change, and its solution in water does not give, on long standing, a precipitate of an anilide. If a solution of the salt is boiled for about ten minutes a yellow precipitate begins to form, which becomes quite copious on long boiling. The solution, after boiling about an hour, was filtered hot, and the yellow precipitate crystallised several times from alcohol. The substance melted at 229° to 230°, and agreed in its properties with the yellow substance obtained by heating a solution of aniline brommaleate. In order to explain its formation it is necessary to assume that phenyl-amido-fumaric acid at the temperature of boiling water changes into the alloisomeric phenyl-amido-maleic acid, which in the presence of aniline decomposes into the anil.

(To be continued).

* Shortly after a preliminary note on this work (*Berichte*, xix., 1376) was sent to the *German Chemical Gazette* for publication, I received Part 6 of the journal that contained a paper by Reissert and Tiemann (xix., 626). These chemists had examined the action of aniline on dibromsuccinic acid, and obtained two compounds that are identical with the products obtained from the halogen fumaric and maleic acids. Reissert and Tiemann considered it probable that the anil represented a dipyridylene, but adopted the view presented in my preliminary note after its publication (Reissert, *ibid.*, xix., 1644). I should like to call attention to the constitution of the condensation products of phenyl-amido-pyrotartaric acid, which Tiemann and Reissert have classified as quinoline derivatives. Although they (*Ibid.*, xix., 624) mention that the compounds have the composition of methyl-fumaranilic acid and methyl-fumaranil, they reject the interpretation that their compounds are really the ones named; but their pyranilpyroinic anhydride has the melting-point of citraconanil (98°), and all the properties of that compound. Its formation is very readily understood when we bear in mind that β-amido acids have a tendency to decompose into unsaturated acids and bases, as is shown in the decomposition of β-amido propionic acid into acrylic acid and ammonia. The formation of citraconanil from phenyl-amido-pyrotartaric acid may be represented by the following equations;—

$$CH_3—C—NHC_6H_5—CH_2 \mid COOH \quad \mid COOH = CH_3—C—CH \mid \mid COOHCOOH + NH_2C_6H_5 =$$

$$= CH_3—C—CH \mid \mid CO\ CO \rangle NC_6H_5 + 2H_2O.$$

If, as Tiemann and Reissert assert, the so-called pyranilpyroinic acid is formed from citraconanil by alkalies, then this acid is citraconanilic acid; although the melting-point of that acid is 175°, and these chemists give 165° for their product. Perhaps a more detailed investigation will disclose the identity of citraconanilic acid with the acid obtained from their so-called anhydride; and if the first condensation product should turn out not to be citraconanilic acid, it doubtless has the constitution—

$$CH_3—C—NC_6H_5—CH_2 \mid COOH \quad CO.$$

VOLUMETRIC ESTIMATION OF SULPHURIC AND PHOSPHORIC ACIDS.

By JOHN TSAWOO WHITE.

THIS note is supplementary to my former article (CHEMICAL NEWS, vol. lvii., p. 165) under the same title. I have made further experiments on the determination and separation, where necessary, of these acids in the form of salts of the alkalies.

Two solutions of potassium sulphate and sodium phosphate were prepared. The strength of these solutions was determined from the weights of the barium sulphate and magnesium pyrophosphate obtained. In a solution containing both sulphate and phosphate, the phosphoric acid may be precipitated as basic magnesium phosphate. Add magnesium chloride in excess, followed by excess of ammonia, evaporate, and ignite. The residue is rinsed into a 250 c.c. flask with water, and diluted to the mark: 50 c.c. of the filtrate are evaporated with some NH_4Cl, and the ignited residue dissolved and titrated; 100 c.c. is treated as for determination of sulphuric acid; and the results are calculated for the total volume. The difference of the two titrations gives the chlorine equivalent of sulphuric acid. The filtrate from the magnesium phosphate contains no phosphoric acid. Five c.c. of a saturated solution of $MgCl_2$ diluted to 250 c.c. will give a solution, 1 c.c. of which will be sufficient to precipitate 0·004 P_2O_5.

I had previously tried to separate the phosphoric acid as ferric phosphate by ferric chloride, the excess of iron being removed by ammonia. The filtrates contained both iron and phosphoric acid, and the results were invariably high.

In determining phosphoric acid in presence of sulphuric acid, even an excess of 50 c.c. silver solution (1 c.c. = 0·001 Cl) in 250 c.c., if it could be completely changed into silver sulphate, would not give a precipitate of Ag_2SO_4, being within the limits of solubility. Below are the results obtained in grammes:—

SO_3.

Taken.	Found.
0·0393	0·0389
0·0393	0·0387
0·0393 + 0·040 P_2O_5	0·0387

P_2O_5.

0·0200	0·0192
0·0200 + 0·0393 SO_3	0·0199

I believe that my results are new. I may, however, be tracing unconsciously the footsteps of a previous worker.

Rangoon, April 11, 1888.

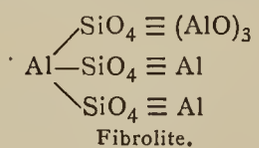
Reproduction of Pharmakolite: a Chemical and Optical Study.—H. Duet.—The author obtains calcium arseniate in a crystalline state, identical in form with the crystals of natural pharmacolite. The composition of pure crystals is given as $2CaO,HO,AsO_5+4HO$, in opposition to the formula $2CaO,HO,AsO_5+5HO$, deduced from the analyses of Klaproth and Rammelsberg.—*Comptes Rendus*, Vol. cvi., No. 17.

THE CHEMICAL STRUCTURE OF THE NATURAL SILICATES.*

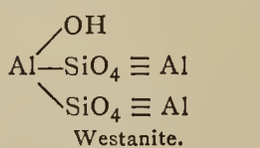
By F. W. CLARKE.

(Concluded from p. 178).

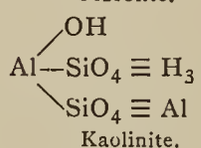
RETURNING now to fibrolite, we find that it is a mineral which is liable to alter through a process of hydration. Some of its alteration products have been described as species, notably under the names wörthite and westanite, the latter being apparently the final product. Certain other species of the same group frequently undergo a sort of degradation into clays, which, unfortunately, are often too impure to admit of precise formulation. Still, of the several clays which are certainly definite, two seem to fall into series with fibrolite and westanite, as the following structures show :—



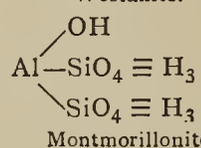
Fibrolite.



Westanite.

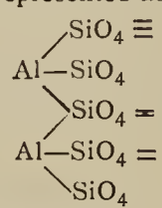


Kaolinite.

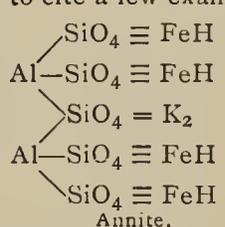


Montmorillonite.

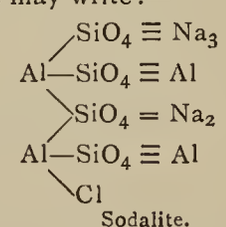
Now, suggestive as these formulæ are, they represent only a selection out of a much larger number, all of which seem to follow essentially the same structural rule. If the case rested here it would still be a strong one, but it becomes even stronger when we study some of the more complex orthosilicates, and some of the silicates containing other inorganic acids. In most of the foregoing instances we have one aluminum atom linked with three of the orthosilicic groups, and making a sort of fundamental nucleus to which the other atoms of each molecule are attached. But in many cases we seem to have a semi-polymerisation of that nucleus which results in the elimination of one of the silicas, leaving a new group of atoms which may be represented as follows :—



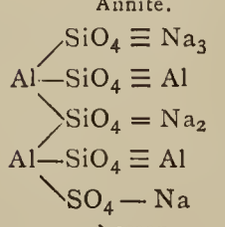
This group, saturated by various bases, seems to exist in many natural silicates, notably among the iron and magnesian micas; and from it certain mixed salts, like sodalite and nosean, may be represented as derived. Thus, to cite a few examples, we may write :—



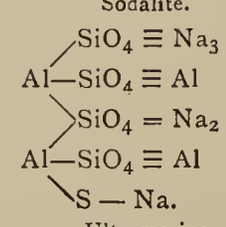
Annite.



Sodalite.



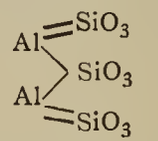
Nosean.

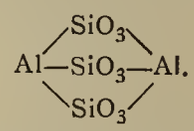


Ultramarine.

The last of these four formulæ is purely hypothetical and rests upon the recognised mineralogical analogies between lapis lazuli and nosean. It is, however, a formula which should be capable of synthetic verification, for ultramarine, itself a product of synthesis, yields many derivatives, the formation of which can be systematically studied. Possibly the lines of research followed by Lemberg, in his work on the alterations of elacolite, may be fitly applied to the investigation of lapis lazuli. As for annite, I have discussed its relations, together with those of the lithia micas, in a previous paper,* in which I have also given some suggestions concerning the part played by fluorine in lepidolite, cryophyllite, and phlogopite. Sodalite and nosean were considered in a still earlier paper,† in connection with cancrinite, nephelite, and other species. It is hardly necessary to repeat either discussion here.

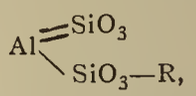
Passing now to the metasilicates, we find ourselves, as regards the aluminous salts, at some disadvantage. The normal compound, $Al_2(SiO_3)_3$, is not known to exist by itself in nature, although certain of its derivatives are common. Its formula, however, may be written in two ways, as follows, and to one of these types some of the double aluminous metasilicates should conform :—



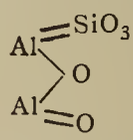


Which of the two is best sustained by evidence?

To answer this question we may appeal to several well-known minerals, such as spodumene, $AlLi(SiO_3)_2$, jadeite, $AlNa(SiO_3)_2$, leucite, $AlK(SiO_3)_2$, and pyrophyllite, $AlH(SiO_3)_2$. All of these can be generalised under one formula, thus :—



which is directly derivable from normal salt No. 1, and is not derivable from No. 2. Furthermore, kyanite, an isomer of fibrolite, Al_2SiO_5, is regarded by Groth and others as a basic metasilicate, for reasons which need not be re-considered here. As such its formula is $Al_2(SiO_3)O_2$, which may be derived from either of the formulæ for the normal compound. But pyrophyllite often occurs as the gangue of kyanite, which suggests a genetic relation between the two, and so makes it highly probable that the latter mineral should be written—



rather than as a derivative of the second formula for $Al_2(SiO_3)_3$. Formula No. 1, then, is the more probable formula for aluminum metasilicate. Two isomers may be possible, but the evidence so far favours only one compound.

In addition to orthosilicic and metasilicic acids, at least two other silicic acids correspond to known salts. These are the compounds $H_2Si_2O_5$ and $H_4Si_3O_8$. Still more are possible, but it is not necessary to assume them in order to account for known minerals. Derived from $H_2Si_2O_5$ we have a few species, notably petalite, $AlLi(Si_2O_5)_2$, which is the equivalent of spodumene in structure. The other acid, $H_4Si_3O_8$, is represented only by the species albite and orthoclase, $AlNaSi_3O_8$ and $AlKSi_3O_8$ respectively. If we triple these formulæ we have structures quite analogous to the orthosilicates, in which the normal aluminum salt $Al_4(Si_3O_8)_3$ is the starting point for derivation. Now it is universally believed, in accordance with the views of Sterry Hunt and Tschermak, that the triclinic felspars consist of various mixtures between albite and anorthite as two extremes. If our fundamental hypothesis is true, each of these minerals is

* *American Chemical Journal*, Vol. x., No. 2.

* *Amer. Journ. Sci.*, Nov., 1886.
† *Amer. Journ. Sci.*, April, 1886.

derived by substitution from a normal salt, and the formulæ so deduced become strikingly suggestive :—

$$\begin{matrix} & SiO_4 \equiv \\ Al- & SiO_4 \equiv Al \\ & SiO_4 \equiv Al \end{matrix} \qquad \begin{matrix} & Si_3O_8 \equiv \\ Al- & Si_3O_8 \equiv Al \\ & Si_3O_8 \equiv Al \end{matrix}$$

Anorthite is the lime salt corresponding to the first formula, and albite is the soda salt corresponding to the second. Another comparison is even more striking. The four silicates, most frequently associated with each other in granite veins, are muscovite, garnet, albite or orthoclase, and tourmaline. Tourmaline, according to the analyses made by Mr. Riggs in the laboratory of the United States Geological Survey, is always represented by the general formula $R'_9BO_2(SiO_4)_2$, in which at least the equivalent of R'_3 is present as aluminum. This gives us the following quartette of formulæ :—

$$\begin{matrix} & SiO_4 \equiv KH_2 \\ Al- & SiO_4 \equiv Al \\ & SiO_4 \equiv Al \end{matrix}$$

Muscovite.

$$\begin{matrix} & SiO_4 \equiv \\ Al- & SiO_4 \equiv \\ & SiO_4 \equiv Al \end{matrix} \Big\} Ca_3$$

Garnet.

$$\begin{matrix} & BO_2 \\ Al- & SiO_4 \equiv R_3 \\ & SiO_4 \equiv R_3 \end{matrix}$$

Tourmaline.

$$\begin{matrix} & Si_3O_8 \equiv K_3 \\ Al- & Si_3O_8 \equiv Al \\ & Si_3O_8 \equiv Al \end{matrix}$$

Orthoclase.

The suggestiveness of these symbols can hardly be questioned. All four are covered by the one general hypothesis; and tourmaline, furthermore, is known to alter into muscovite.

Leaving the aluminous salts, the other silicates present few structural difficulties. Isomorphous mixtures become perhaps more common, but when they are resolved into their constituents relatively simple compounds are found. The commoner bivalent metals form both ortho- and meta-silicates, and to them the substitution hypothesis, as a rule, easily applies. Only in the meta-silicate series do we find notable difficulties, and they may be avoided by the assumption of polymeric molecules. Thus, instead of $R''SiO_3$, we should write $R''_2(SiO_3)_2$, in which one atom of R'' becomes replaceable. This conception is by no means new, and is indeed quite commonly in use; but I may be permitted to cite one item of evidence in its favour. When solutions of calcium chloride and sodium meta-silicate are mixed, a white precipitate of calcium metasilicate is thrown down. This reaction I have studied under various conditions of temperature and concentration, and I find that when the precipitated salt is carefully dried over sulphuric acid it has the composition $2CaSiO_3.5H_2O$. That is, the double molecule $Ca_2Si_2O_6$ is required in order to avoid a formula containing a half molecule of water. By itself this fact is not of weighty importance, but it counts for something in confirmation of the prevalent views.

Concerning mixed silicate molecules, partly ortho- and partly meta-compounds, I have nothing at present to say. Such silicates undoubtedly exist, as well as aluminous silicates derived from normal salts of magnesia or lime. Nor do I venture to assert that all known silicates are as yet interpretable by simple structural means. There are many outstanding cases which still seem very obscure, but which I confidently expect will be cleared up in time. The micas, chlorites, and scapolites especially need a great deal of farther study. Various theories have been proposed to account for the composition of these groups, but not one is absolutely conclusive and satisfactory. The new method of discussion which I have proposed is yet to be fully applied to these minerals, but a wider knowledge of their variations is essential to its complete application. Whether the method shall be finally established as valid remains to be seen, but its results so far, at least entitle it to respectful consideration. As a working hypothesis the substitution theory has value, even though it should be ultimately overthrown.

In conclusion, there is one question to be considered. With the silicates the supposition that double salts are substitution derivatives of normal salts appears to work exceedingly well. But how about double salts in general? With such compounds as the sulphates, chromates, tartrates, oxalates, &c., there seem to be few difficulties; but with the double haloids, acetates, formates, &c., the case is not so clear. Their explanation is troublesome, at least in accordance with current views concerning the valency of their acid radicles; but those views are not absolutely incapable of modification. There may be exceptions to the general hypothesis of derivation, but chemists are not likely to be satisfied with partial theories, and all double salts ought to come under one common law. Toward that ultimate purpose the present paper tends, even though the road which it opens may not reach the final goal.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, May 1, 1888.

Sir Frederick Bramwell, D.C.L., F.R.S., Honorary Secretary and Vice-President, in the Chair.

The Annual Report of the Committee of Visitors for the year 1887, testifying to the continued prosperity and efficient management of the Institution, was read and adopted. The real and funded property now amounts to above £81,000, entirely derived from the contributions and donations of the members.

Forty-one new Members were elected in 1887.

Sixty-three lectures and nineteen evening discourses were delivered in 1887.

The Books and Pamphlets presented in 1887 amounted to about 283 volumes, making, with 463 volumes (including periodicals bound) purchased by the Managers, a total of 746 volumes added to the Library in the year.

Thanks were voted to the President, Treasurer, and the Honorary Secretary, to the Committees of Managers and Visitors, and to the Professors, for their valuable services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year:—

President—The Duke of Northumberland, K.G., D.C.L., LL.D.

Treasurer—Henry Pollock.

Secretary—Sir Frederick Bramwell, D.C.L., F.R.S., Mem. Inst. C.E.

Managers—George Berkley, M. Inst. C.E.; Sir James Crichton Browne, M.D., LL.D., F.R.S.; Vicat Cole, R.A.; Frank Crisp, LL.B., B.A., F.L.S.; William Crookes, F.R.S.; Warren de la Rue, M.A., D.C.L., F.R.S.; Sir Henry Doulton; John Hall Gladstone, Ph.D., F.R.S.; Colonel James A. Grant, C.B., C.S.I., F.R.S.; The Rt. Hon. Sir William R. Grove, D.C.L., F.R.S.; Rev. John Macnaught, M.A.; Sir Frederick Pollock, Bart., M.A.; William Henry Preece, F.R.S., M. Inst. C.E.; John Rae, M.D., LL.D., F.R.S.; Sir Henry Thomson, F.R.C.S.

Visitors—Capt. W. de W. Abney, R.E., F.R.S.; William Anderson, M. Inst. C.E.; Benjamin Baker, M. Inst. C.E.; John Birkett, F.R.C.S.; Michael Carteighe, F.C.S.; James Farmer; John Piggin Fearfield; Ernest H. Goold, F.Z.S.; Charles Hawksley, M. Inst. C.E.; David Edward Hughes, F.R.S.; Thomas John Maclagan, M.D.; Lachlan Mackintosh Rate, M.A.; John Bell Sedgwick, J.P., F.R.G.S.; Basil Woodd Smith, F.R.A.S.; James Wimshurst.

NOTICES OF BOOKS.

Half-Yearly Report (from July to December, 1887) of the Medical Officer of Health, Port of London.

An interesting and important report upon the sanitary condition of the Port of London during the last six months has recently been presented to the Corporation by Dr. Collingridge, the Medical Officer for the Port of London. This shows that 10,587 vessels of all classes have been inspected in the district, and that of these no fewer than 9298, or 87·83 per cent, were under the British flag, a larger proportion than usual.

These vessels were mostly found to be in a thoroughly sanitary condition, and in 831 cases only was it found necessary to order cleansing of any part to be carried out.

The majority of these orders were carried out promptly and willingly, and in no case had legal proceedings to be taken.

Eleven vessels were fumigated on account of infectious disease having occurred on board, and in eight cases parcels of clothing were fumigated. In 135 vessels some structural alterations were carried out with a view to improve their sanitary condition. Dr. Collingridge says, "with regard to these structural alterations, I would again point out the great economy that would be exercised by ship-owners and builders if they would only consult experts during the construction or repairs of vessels, when the expense of improvement is always nominal, and often non-existent," and suggests that an inspection of sanitary arrangements without expense to the owner should be made compulsory.

Attention is again called to the unsatisfactory state of the river, and some complete scheme urged for dealing with the sewage of the metropolis.

A few isolated cases of small-pox occurred in the Port, and as these present interesting points a few brief particulars are given of each. In one case a telegram from the Medical Officer of Health for Plymouth stated two cases of small-pox were coming round to London in s.s. *Kaikoura*. The vessel arrived at Gravesend the following day, and three cases (one of which subsequently died) were removed to the Port Sanitary Hospital. She was fumigated on her way up the river to the docks. The vessel left Wellington on August 25, and arrived at Rio de Janeiro on Sept. 16, small-pox being then very prevalent in that port. Here they embarked nine seamen, one of whom sickened with the disease on October 1st, and two others on the 2nd. The six healthy seamen were landed at Plymouth and the small-pox patients sent on to London.

Notice was sent to the Medical Officer of the Local Government Board protesting against the practice of passing disease in from an outport to London. There is firstly the increased danger of the ship's complement by reason of the longer exposure to infection; secondly, the risk of introducing disease into London; and thirdly, the objectionable, though probably convenient, practice of saddling the Corporation of London with the expense of maintenance and treatment which should properly fall upon the Plymouth Port Sanitary Authority. Dr. Collingridge further states that no cholera has been existent on the Continent within what may be termed dangerous distance of our shores, though obviously there is a possibility of its being conveyed by ship from *any* infected port.

The order issued by the Local Government Board prohibiting the importation of rags from Italy expired on December 31, 1887. In only one case was any action under this order required. The morality of allowing rags to be sent to another port when officially convinced of the danger of admitting them to our own is, to say the least, very doubtful. The absurdity of the present arrangement, moreover, is apparent when one considers that in all probability the same rags were re-imported from some other port not coming within the terms of the order. How much simpler and how much more reasonable to insist upon the disinfection of all rags entering the country. If this was carried out by the Port Sanitary Authorities it could be done at a nominal rate, and one great source of danger would be removed. Cholera is a rare danger, but other diseases, notably small-pox, have repeatedly been remitted by means of infected rags.

A large number of mild cases of scarlet fever and mumps occurred on the *Worcester* Thames Training College, off Greenhithe. The source of infection was not definitely traced, though in all probability derived from London, where the disease was more prevalent than usual.

The report, in referring to infected clothing, points out that although the dangerous practice of sending home clothing of persons who have died from infections has greatly diminished, still cases occur from time to time.

In thirteen cases unsound meat has been destroyed on account of its condition. In all except one instance the quantity fortunately was small. The one exception involved the destruction of over 5000 quarters of beef.

The Hospital has received only eight cases during the half-year; of these, five were admitted for small-pox, two for chicken pox, and one for enteric fever.

Canal Boats.—During the last twelve months 721 have been inspected; speaking generally, these boats are found in good condition and well cared for. The enforcement of the Act has done much for the physical and moral improvement of their inhabitants. These 721 boats were registered for a population of 2867, and carried only 1940. No case of infectious disease has occurred on canal boats during the last twelve months. It has only been necessary to prosecute in seven cases; in six fines were inflicted.

Notes on Inorganic Evolution. By E. A. Ridsdale, Associate of the Royal School of Mines. London: H. K. Lewis.

In this small pamplet the author has taken what seems to us a great step in working out the question of inorganic evolution. He introduces a new and luminous principle, the "survival of the most inert." He points out that if the chemical changes which we recognise in the world are taking place in some one direction, they must afford a clue to the past career of our globe. No one will question but that, generally speaking, bodies held together by feeble affinities tend to be broken up, while those held together by stronger affinities remain unchanged. But compounds may also persist if their elemental affinities are feeble, so that they have no disposition to enter into any new combination. Hence the body which survives is that which, as a whole, is most inert, that which is least likely to react with adjacent bodies. On the other hand, the least inert bodies must tend to disappear.

Whatever conditions may prevail in coming ages, the author thinks it likely "that bodies inert under such conditions will tend to accumulate, whilst the more active bodies will be combined and re-combined until they are effaced in an inert condition."

Few chemists probably, on due consideration, will hesitate to follow Mr. Ridsdale so far, especially if they weigh the evidence which he adduces. But if we admit the "survival of the most inert" we find ourselves face to face with a number of conclusions, strongly probable, if not absolutely certain. We are led to see that "bodies which may appear to be elements under one or even many environments, may be easily broken up when the conditions are unfavourably altered." The author submits that, though these considerations are "not a proof that there may not be one or more true elements capable of withstanding every possible environment, there is strong presumptive proof that many, if not all, of the so-called 'elements' are elemental only inasmuch as we have not yet been able to isolate a sufficiently powerful set of conditions." He continues:—"Every chemical body is

'elemental'—*i.e.*, undecomposable—to some set of conditions, or it could not exist, and an element *may* only be a body stable under more extreme conditions than usual." This theory naturally leads to the conclusion that in every group of elements those with the lowest atomic weights were formed first, and those with the highest last. Bodies with high atomic weights, being formed under conditions of "greater chemical lethargy," would tend each to be more inert than its predecessors of the same series, as we find so signally shown in the halogen group.

We do not propose following the author any further at present, but we would bespeak for his work the most careful scrutiny. His fundamental idea, the survival of the most inert, deserves to be kept well in view during chemical research and geological observation. Unless we are much mistaken it will prove highly fruitful.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 17, April 23, 1888.

The Fixation of Nitrogen by Vegetable Mould. Reply to the Observations of M. Schlœsing.—M. Berthelot.—The author maintains that microbia induce in the soil not merely decompositions, as formerly admitted, but also true syntheses.

Certain Spectral Rays of Gold.—Eug. Demarçay.—The author criticises an investigation by Prof. G. Krüss, who, on revising the rays of gold and comparing his own results with those obtained by M. Lecoq de Boisbaudran, found several of the rays of the latter author wanting, and ascribed this discrepancy to traces of platinum and palladium examined by M. de Boisbaudran. He takes up the four rays specified by Prof. Krüss as wanting, *i.e.*, 523·0, 443·7, 433·8, and 406·4, and maintains that the first-mentioned is due neither to platinum nor palladium, but is one of the strong rays of gold. The ray 443·7 coincides with a faint platinum ray, but it may be seen in the entire absence of that metal. The ray 433·8 does not fall near any ray of either platinum or palladium, and is pronounced due to the process employed by Prof. Krüss; 406·4 coincides with a faint ray of platinum, but is seen in the complete absence of that metal.

Combustion-heat of the Coal of Northern France.—M. Scheurer-Kestner.—The most effective coals which have come into the author's hands are those of Creuzot.

Researches on the Fixation of Nitrogen by the Soil and Plants.—Arm. Gautier and R. Drouin.—The authors conclude that the bare soil acquires, from the atmosphere, notable quantities of nitrogen if it contains organic matter, such as humus, the necessary medium of such fixation. The iron oxides accelerate the process, but are not absolutely necessary. Thénard observed, in 1859, that at 100° they become agents in nitrification, but no nitre has been generated in the author's experiments. Whatever may be its initial state, the nitrogen thus withdrawn from the atmosphere is converted into organic nitrogen. The soil is the seat of a constant loss of the ammoniacal nitrogen brought by the wind and the rain, or derived from bacterian fermentations. In the fixation of nitrogen by the soil its permeability, state of division, and heaping up, play a considerable part. Soils heaped up and rendered little permeable by means of a slight excess of kaolin, or by varnishing the part in which they are contained, absorbed in an equal time thirteen times less nitrogen than the same soils rendered physically permeable. The total quantity of nitrogen assimilated by bare soils in three months in presence of organic matter are, on an equal area and in the same time, ten times greater than the quantities of ammoniacal nitrogen fixed by acidulated water exposed to the air of the fields in the experiments of M. Schlœsing. The intervention of plants doubles the total quantity of nitrogen fixed.

Researches on Perseite.—M. Maquenne.—Perseite, discovered by Muntz and Marcano in the leaves and fruits of *Laurus persea*, is a hexatomic mannite, and consequently, as was surmised by its discoverers, a true isomer of the mannite of manna and of dulcite.

Moniteur Scientifique, Quesneville. Series 4, Vol. ii., February, 1888.

Industrial Society of Mulhouse.—Meeting of December 14, 1887.

M. Scheurer read a note from M. Albert Frey on the use of De Haen's "antimony salt" in dyeing and printing. This salt is a combination of antimony terfluoride and ammonium sulphate readily soluble in water, containing 47 per cent antimony sesquioxide, and having a strongly acid reaction. Its solution attacks glass and metals, and should consequently be used only in wooden vats. If employed for fixing tannin it should be neutralised with half its weight of soda crystals. The quantity to be used per litre is 4 grms. of the antimony salt and 2 grms. soda crystals, taking the pieces through the solution at 50°; 4 grms. of the antimony salt take the place of 5 grms. of the double tartrate. The shades are brighter than those obtained with tartar-emetic, and the whites purer, which proves that the colouring-matter is better fixed.

M. Noelting read a note from M. St. de Kostanecki on the relations existing between the constitution of colouring-matters and their power of dyeing mordanted tissues.

M. Scheurer read a letter from M. Albert Schlumberger with specimens of the author's safety envelopes. They are tinted in such a manner as to turn black, blue, and red, if an attempt is made to open them by wetting or by exposure to steam, whilst moist air or fog does not affect them.

M. Noelting gave in, on behalf of Dr. G. Lunge, of Zurich, a memoir on the reactions which take place in the lead-chambers.

Effects upon the Ductility of Silver produced by Traces of Bismuth.—The author adds to the solution the smallest possible quantity of hydrochloric acid requisite for the complete precipitation of the silver and increases the quantity of nitric acid in which the metal was dissolved.

Claim of Priority against Prof. Lothar Meyer on the Subject of the Action of the Carbon Chlorides.—H. Quantin.—See *Comptes Rendus* for January 27th, 1887.

March, 1888.

Studies on Diastase.—C. J. Lintner.—From the *Journal fur Praktische Cnemie.*

Contributions to the Study of Levulose.—H. Winter.—The author concludes that the specific rotatory power of levulose in an aqueous solution at 20 per cent is $-71·4°$ at a temperature of 20°. The method of preparation and the raw material employed have no influence upon the optical properties of the product. Levulose may be dried at 50° in a vacuum without change, and has then the composition $C_6H_{12}O_6$. Alcohol considerably reduces the rotatory power of levulose, but slightly augments that of dextrose. The specific rotatory power of pure anhydrous levulose in solution in absolute alcohol is $-47°$ for $P=7·78$. A mixture of equal parts of levulose and dextrose does not possess the optical properties of inverted sugar. Levulose combines with calcium oxide, lead oxide, chloride, and nitrate, and bismuth nitrate. The author further advances, though with some reservation, that two parts of levulose and one

part of hydrated dextrose form a crystalline compound. Inverted sugar is composed of four parts of levulose and three parts of hydrated dextrose. Levulose forms an alcoholate of the formula $C_6H_{11}O_6(C_2H_5)$.

Lecture delivered before the Society of Arts in London on the Chemistry of Substances which Play a Part in Putrefaction and Antiseptics.—J. Thomson.

Destruction of Rabbits in Australia and in New Zealand.—M. Pasteur.—The subject matter of this memoir, which is biological rather than chemical, has been repeatedly before the public.

Influence of Sodium Nitrate upon Gun-cotton.—F. Nettlefold.—From the CHEMICAL NEWS.

On a Sulphur Island in New Zealand.—Emerson Macivor.—From the CHEMICAL NEWS.

Effects of Small Quantities of Bismuth on the Ductility of Silver (concluded).—As long as ingots contain less than 0·5 of bismuth per thousand their ductility is not materially decreased.

Further Contributions to the Metallurgy of Bismuth.—E. Matthey.—A paper communicated to the Royal Society.

The Alkali Industry in England.—A. Fletcher.—A paper read before the British Association at its last meeting.

Chemical Patents taken out at Berlin.—Preparation of acetic acid with simultaneous production of charcoal. Dr. R. Weids. W, No. 5022.

Preparation of hydrated alumina from alkaline earths. Dr. K. Bayer. B, No. 7849.

Preparation of chromium and its alloys. V. E. Rouff. R, No. 4347.

Production of ammonia from desaccharised treacle without previous calcination and simultaneous production of oxalic acid. Dr. E. Meyer. M, No. 5334.

Saponification of fatty bodies with ammonia for the production of soda-soaps. Carl Polony. P, No. 3374.

New salt of soda and method of its preparation. J. J. Watts and W. A. Richards. W, No. 4892.

Reduction of nitro-compounds by means of zinc-powder, with or without the aid of iron, and in saline solutions. Dr. Dechend. D, No. 2927.

Preparation of a methyl-gallic ether and of a derived colouring-matter. Kern and Sandoz. K, No. 5468.

Preparation of red, violet, and blue colours by means of the tetrazo-derivative of ortho-diamido-diphenic acid. Baden Aniline Co. B, No. 7141.

Improvement in preparation of azo-colours. E. Kegel. K, No. 5613.

Preparation of soluble indulines. Dahl and Co. D, No. 3149.

Preparation of a blue azo-colour with diamido-stilbene. Berlin Aniline Company. A, No. 1643.

Preparation of blue azo-colours from diamido-stilbene. Berlin Aniline Company. A, No. 1662.

Improvement in the production of mixed azo-colours derived from tetrazo-diphenyl or tetrazo-ditolyl. Berlin Aniline Co. A, No. 1064.

Improvement in the production of mixed azo-colours derived from benzidine or tolidine and α-amido-naphthaline-δ-disulphonic acid. Berlin Aniline Co. A, 1724.

Preparation of bluish red azo-colours derived from benzidine or tolidine. F. Bayer and Co. F, No. 3163.

New mono-sulphonic acid from α-naphthol. Liebermann and Studer. L, No. 4327.

Preparation of ortho-nitrophenol. F. Bayer and Co. F, No. 3286.

Determination of Tannin.—Ch. Colin and L. Benoist. —This paper will be inserted at some length.

Process for Oil of Sesame. — E. Milliau. — By operating upon fatty acids obtained as above described, expelling the water by heating to 110°, and pouring them then into a test-tube upon an equal volume of hydrochloric acid mixed with sugar, we obtain a rose colour if oil of sesame is present. If the olive oil is pure the mixture remains colourless.

Manufacture of Tofu in Japan.—From the *Journal of the Society of Arts.*

Industrial Society of Mulhouse. — Session of the Chemical Committee, January 11, 1888.

E. Dollfus remarked, concerning the double salt of antimony fluoride with ammonium sulphate, that it fixes tannin perfectly, but notwithstanding the addition of sodium carbonate, the dunging process may have an unfavourable action upon certain colours associated with the tannin colours. Thus, berry-yellows lose their intensity. This action, however, is especially manifested at a temperature above 50°.

M. Noelting handed in, on behalf of Dr. Otto Witt, a memoir on the constitution of the colouring-matters of the groups of the azines, of the azonium bases, and of the saffranines.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Detection of Cotton Fibre.—Could any of your readers oblige by describing a method (reliable) for the detection of cotton in white or coloured woollen stuffs?—J. E. G.

MEETINGS FOR THE WEEK.

MONDAY, 14th.—Society of Arts, 8. "Decoration," by G. Aitchison, A.R.A.
TUESDAY, 15th.—Institution of Civil Engineers, 8.
—— Pathological, 8.30.
—— Society of Arts, 8. "Duty of the State towards Emigration," by James Rankin, M.P.
—— Royal Institution, 3. "The Plant in the War of Nature," by Walter Gardiner, M.A.
WEDNESDAY, 16th.—Meteorological, 7.
—— Pharmaceutical, 11. (Anniversary).
—— Society of Arts, 8. "Electric Lighting from Central Stations," by R. E. B. Crompton.
THURSDAY, 17th.—Royal, 4.30.
—— Royal Institution, 3. "The Chemical Arts," by Professor Dewar, M.A., F.R.S.
—— Parkes Museum, 5. "Healthy Clothing," by Lewis R. S. Tonalin.
—— Chemical, 8. Ballot for the Election of Fellows. "Researches on the Constitution of Azo- and Diazo-derivatives. IV. Diazo-amido Compounds," by Prof. R. Meldola, F.R.S., and F. W. Streatfield, F.I.C.
FRIDAY, 18th.—Quekett Club, 8.
—— Royal Institution, 9. "La Reproduction Artificielle des Roches Volcaniques," by M. Alphonse Renard, LL.D.
SATURDAY, 19th.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.

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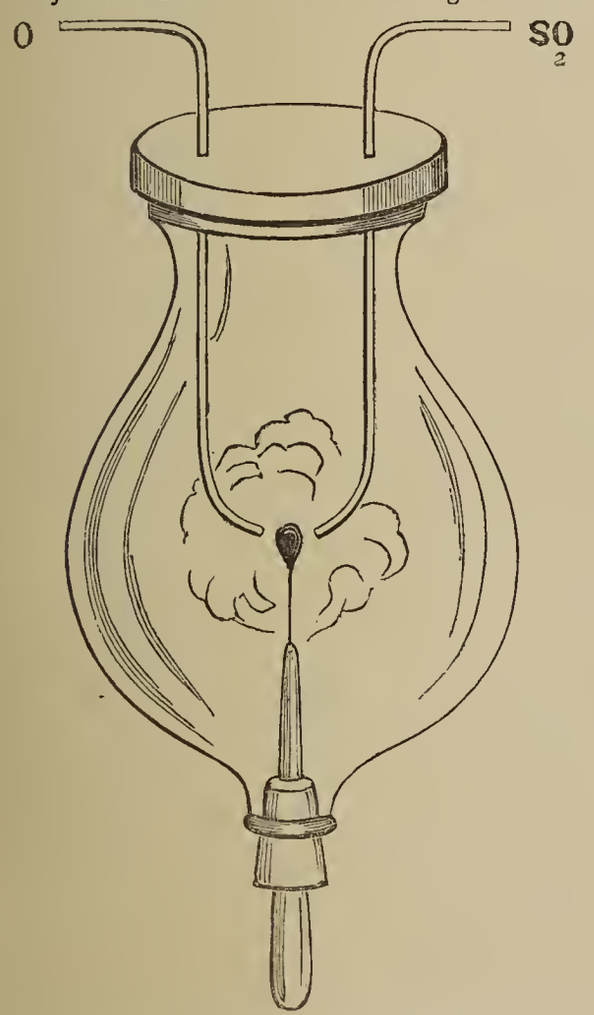
THE CHEMICAL NEWS.

Vol. LVII. No. 1486.

A NEW LECTURE APPARATUS FOR MAKING SULPHURIC ANHYDRIDE.

By Dr. W. R. HODGKINSON and F. K. LOWNDES, F.C.S.

We have lately designed a piece of apparatus which exhibits in a most striking manner the oxidation of SO_2, by means of oxygen in presence of spongy platinum, and which we think will be of interest and use to other lecturers. It consists, as the sketch will show, of an inverted bell-jar having an aperture at each end; through the lower one is pushed a caoutchouc stopper having passed through its centre a small rod of wood, attached to the upper end of which is a piece of moderately thick platinum-wire, holding in its position in the centre of the jar a block of spongy platinum. The upper aperture of the bell-jar is closed with a well-fitting but not fixed



piece of wood, through which are pushed two glass tubes bent at right angles outside, and inside curved so as to impinge on to the platinum, as shown. The block of sponge is raised to a moderately high temperature in a Bunsen flame, and pushed into its place; streams of oxygen (or even air) and sulphur dioxide are then passed through their respective tubes: instantly the globe becomes filled with vapour of sulphur trioxide, and if the supply of gases is steady, and not too violent, a large quantity of this substance can be made in a very short space of time. The experiment is still more striking if the SO_2 be passed for a short time before starting the oxygen, or *vice versâ*.

Royal Military Academy, Woolwich,
May 7, 1888.

ON THE ANALYSIS AND COMPOSITION OF ANTIMONIUM POTASSIUM OXALATE.

By PERCY KAY.

Having had occasion recently to determine the amount of antimony in a sample of double oxalate of antimony and potassium, of undoubted purity, I was surprised to find a considerably higher proportion of antimony than corresponds to the formula $K_3Sb(C_2O_4)_36H_2O$, which requires 19·71 per cent Sb. The amount found was 24·84 per cent. I therefore thought it would be of interest to make a complete analysis. The following methods were used.

(*a*) *Estimation of the Antimony.*—5 grms. of the substance was dissolved in water and diluted to 500 c.c. 50 c.c. (1 grm.) were taken, tartaric acid solution added in excess, excess of acid nearly neutralised with sodium carbonate, then 20 c.c. of a saturated solution of potassium bicarbonate added. An excess of calcium hypochloride of known strength was next added, the excess being found by arsenite solution of known strength, until the liquid ceased to give a blue colour with starch iodide paper. The strength of the bleaching solution was found by titration with arsenite, starch iodide paper being used as indicator. The arsenite solution contains 5 grms. As_2O_3 per litre. 1 c.c. = 0·006 grm. Sb = 0·0072 grm. Sb_2O_3.

(*b*) *Potassium.*—2 grms. of the substance was ignited at a low red heat, by which means the oxalates are converted into carbonates. The mass was extracted with water, and the solution titrated with standard sulphuric acid and methyl orange. 1 c.c. = 0·039 grm. K (results slightly below true amount). A preferable method is to precipitate the antimony with ammonia, filter, evaporate filtrate to dryness, ignite, dissolve in water, and titrate with acid as before.

(*c*) *Water.*—The substance (2 grms.) was dried at 100° C. till constant. Time required about two hours.

(*d*) *Oxalic Acid.*—50 c.c. of the solution were acidified with acetic acid, calcium chloride solution added, the solutions heated on water-bath for about three hours, solution filtered, precipitate washed with hot water until washings were free from chlorine. A hole was then made through the filter, the greater part of the precipitate washed into a flask, residue on filter dissolved into the flask by means of hot dilute hydrochloric acid. Sulphuric acid is now added, and the contents of the flask heated to 60° C., titrated with N/10 $KMnO_4$. 1 c.c. = 0·0044 grm. C_2O_4.

Calculated to the formula $K_4Sb_2(C_2O_4)_6.3H_2O$—

	Found. Per cent.	Calculated. Per cent.
Potassium	15·21	15·94
Antimony	24·84	24·54
Oxalic acid (C_2O_4)	54·03	53·98
Water	5·85	5·54
	99·93	100·00

Calculated to $K_3Sb(C_2O_4)_3.6H_2O$—

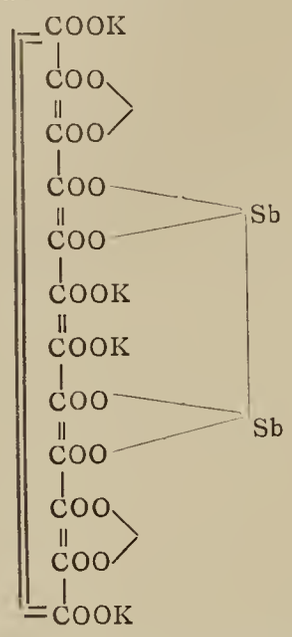
	Per cent.
Potassium	19·21
Antimony	19·71
Oxalic acid (C_2O_4) ..	43·35
Water	17·73
	100·00

The substance was next re-crystallised and dried and again analysed.

Calculated to $K_4Sb_2(C_2O_4)_6$—

	Found. Per cent.	Calculated. Per cent.
Potassium	16·57	16·88
Antimony	26·23	25 98
Oxalic acid (C_2O_4)	57·11	57·14
	99·91	100·00

The specimen was manufactured by Casella and Co. It may be perhaps represented constitutionally by the following formula :—



A second sample (Rudolf Koepp, Castrick in Rheingau) gave the following results on analysis by the above methods.

Calculated to formula $K_3Sb(C_2O_4)_3.2H_2O$—

	Found. Per cent.	Calculated. Per cent.
Water	6·30	6·71
C_2O_4	53·15	49·16
Sb	20·96	22·34
Potassium	19·69	21·79
	100·10	100·00

The potassium was found by precipitating the antimony by ammonia, filtering, evaporating to dryness, igniting, and titrating with acid as before.

The antimony in this sample was estimated by dissolving in water and titrating with N/10 KHO, phenolphthaleine being used as indicator (pink colour). 1 c.c. = 0·004 grm. Sb.

By the arsenite process 21·12 per cent of antimony was found.

This second sample was stated to correspond to the formula $K_3Sb(C_2O_4)_3.6H_2O$. The water was determined at 100° C.

Technical College, Bradford.

THE RELATIONS BETWEEN THE ATOMICITY OF THE INORGANIC ELEMENTS AND THEIR BIOLOGICAL ACTION.

By Dr. J. BLAKE.

THE author has found, when studying the biological action of a great number of inorganic compounds when injected into the circulatory system of living animals, certain very interesting facts, depending on the molecular properties of the substances employed.

He has demonstrated, in a memoir read before the Academy long ago, that the biological action of these inorganic substances is determined by the electro-positive element of the salt employed. He has since shown that the biological action of such substances is connected with the isomorphic relations of the elements; that all substances forming one and the same isomorphous group have a similar biological action; and that in each isomorphous group the intensity of the biological action is a function of the atomic weight (*Comptes Rendus*, xcvi., p. 409).

He proposes at present to call attention to certain interesting relations which exist between the atomicity of the elements and the reactions which they produce in living matter. His experiments have been made with the monoatomic, diatomic, triatomic, and tetratomic elements.

Among the monoatomic elements he has studied the action of the salts of lithium, sodium, rubidium, silver, cæsium, and thallium; among the diatomics, that of the salts of magnesium, chromium, manganese, iron, cobalt, nickel, copper, zinc, and cadmium, and also that of the salts of calcium, strontium, barium, and lead; among the triatomics the action of salts of aluminium of iron (ferricum), of gold, yttrium, cerium, (Ce_2O_3), lanthanum, erbium, and didymium; and among the tetratomics the salts of platinum, palladium, cerium, (CeO_2), thorium, uranium, and titanium.

Among elements having the same atomicity there are found some belonging to different isomorphic groups. The biological action of these different elements is not identical in several respects, but we find that the atomicity of an element is always an important factor as regards the extent of its biological action, or as to the number of organs to which its action extends. Among the elements whose salts have not all the same atomicity it is always the salt having the strongest atomicity whose biological action is the most extended,—a fact ascertained on comparing the action of the thallous and thallic, ferrous and ferric, cobaltous and cobaltic, cerous and ceric salts. The monoatomic elements, when injected into veins in physiological doses, kill by their action upon the pulmonary arteries. They can circulate in the blood without giving rise to any decided reaction upon the nerve-centres. Even if injected into the carotid so that they arrive at the nerve centres in a state of considerable concentration, they do not at all disturb the functions of the brain, the bulb, or the spinal marrow.

The biatomic elements consist of two isomorphous groups whose biological action differs in several respects, but all the biatomic elements differ from the monoatomic elements by causing more extended biological reactions. The salts of the magnesian and the barytic group kill by paralysing the heart, but those of the magnesian group act also upon the centre of vomiting, and those of the barytic group upon the voluntary muscles, the irritability of which they keep up long after death. The triatomic elements have a much more generalised biological action. The respiratory, vasomotor, and inhibitory centres, and the cardiac ganglia, are all more or less affected. Besides nearly all these elements act upon the pulmonary arteries.

The tetratomic elements produce upon the nerve-centres reactions still more pronounced, especially as regards the respiratory and vasomotor centres. Sensibility and the reflexes are abolished before the dose is strong enough to arrest respiration, and all, if injected into the veins, determine the contraction of the pulmonary arteries.

The following table sums up the facts just explained :—

Monoatomic Elements.—Action upon the pulmonary arteries.

Biatomic Elements.—Action upon the centres of vomiting and upon the voluntary and cardiac muscles. The only diatomic element which acts upon other nerve-centres is glucinum, an element which in its oxygen compounds seems to occur in a trivalent form,—a point upon which chemists are not agreed.

Triatomic Elements.—Action upon the respiratory, vasomotor, and inhibitory centres, upon the cardiac ganglia and the pulmonary arteries.

Tetratomic Elements.—Action upon the respiratory, vasomotor, and inhibitory centres, upon the brain, the spinal marrow, the cardiac ganglia, and the pulmonary arteries.

The facts just mentioned enable us to establish a further link between the chemical constitution of the elements and their biological action.

The author has already demonstrated the important part played by isomorphism and atomic weight in acting upon living tissues, and we may now also regard atomicity as another important factor. These relations may furnish important assistance in researches in molecular chemistry. It must not be forgotten that when Mr. Newlands published the "periodic law" he made the interesting observation that all the elements which are found in organised bodies have atomic weights below 40. It may now be added that all the electro-positive elements found in organised bodies are monoatomic or diatomic.—*Comptes Rendus*, cvi., 1250.

RESEARCHES ON ALLOISOMERISM.*

I.

By ARTHUR MICHAEL.

(Continued from . 187).

Behaviour of Chlorfumaric Acid towards Aniline.

FIVE grms. of monochlorfumaric acic (melting-point 183°: obtained by the action of phosphorus pentachloride on tartaric acid) were dissolved in one hundred grms. of water, and two and one-half grms. of aniline added. The aniline went into solution, and presently a crystalline substance separated. For analysis it was crystallised twice from alcohol.

0·2736 grm. air-dried substance gave 0·1610 grm. AgCl.

	Theory for $\begin{matrix}CCl—COONH_3C_6H_5\\ \vert\\ CH—COOH.\end{matrix}$	Found.
Cl	14·57	14·55

Acid aniline chlorfumarate crystallises from alcohol as white monoclinic prisms with domes, that melt at 178°, but begin to turn yellow at about 170°. It is difficultly soluble in cold water and alcohol, but readily in chlorhydric acid, when it decomposes into chlorfumaric acid and aniline chlorhydrate. This salt or its aqueous solution may be allowed to stand for weeks with water without undergoing any change. An aqueous solution of the salt behaves on boiling like the corresponding bromfumaric acid salt; only its conversion into the anil of phenyl-amido-maleic acid proceeds with less readiness. When a solution of the salt is boiled a number of minutes, the unchanged salt is deposited on cooling. If the boiling is continued for some time the solution gradually turns yellow, and the yellow anil begins to separate. This was purified as already described, and gave the same compound as obtained from brommaleic and bromfumaric acids.

0·1573 grm. substance gave 0·4195 grm. CO_2 and 0·0677 grm. H_2O.

	Theory for $\begin{matrix}CNHC_6H_5—CO\\ \vert\\ CH\end{matrix}\!\!>\!\!\begin{matrix}\\ —CO\end{matrix}\!\!>C_6H_5$.	Found.
C	72·73	72·76
H	4·55	4·79

The formation of the same compound from brommaleic, brom- and chlorfumaric acids when aqueous solutions of their neutral aniline salts are boiled, is of considerable theoretical importance, as it implies the conversion of derivatives of fumaric acid into a maleic acid compound at the temperature of boiling water, a fact that can only be brought in harmony with Fittig's views of the constitution of these compounds with the assumption of improbable inter-molecular changes. I shall return to the subject in a discussion of the bearings of the present investigation on the constitution of the acids in question.

Behaviour of Dibrommaleic Acid towards Aniline.

This reaction is complicated, and, acccording to the conditions of the experiment, a number of different products are formed, which, however, are difficult to obtain in a pure state.

To a solution of the acid in thirty parts of water an equivalent proportion of aniline was added. The base dissolved, and immediately the very difficulty soluble acid aniline dibrommaleate was deposited. This salt dissolves in dilute chlorhydric acid, to form the free acid and aniline chlorhydrate. If it is allowed to stand under water for a number of days it gradually loses water to form an anilide, which decomposes when heated with water or other solvents, and could not be obtained in a state suitable for analysis. The neutral salt, formed on adding two equivalents of aniline to a solution of one of the acid, is also quite insoluble. It dissolves in dilute chlorhydric acid. When allowed to stand under water for a long time it also passes over into an anilide that may be separated from any unchanged salt by treating with dilute chlorhydric acid. This salt, when heated in a solvent, goes over into a mixture of a yellow substance that is described further on, and unchanged substance. As it was found impossible to crystallise the substance without its undergoing a partial change, it was dried in a vacuum and analysed.

0·2224 grm. substance gave 0·2041 grm. AgBr.

	Theory for $\begin{matrix}CBr—CONHC_6H_5\\ \vert\\ CBr—CONHC_6H_5.\end{matrix}$	Found.
Br	37·73	38·98

The substance probably contained a small amount of the anil, but the analysis is sufficiently close to show that the product analysed consisted largely of the dianilide. It was obtained as plates that melted at 138°—140°. The anil is probably obtained by crystallising the anilide, obtained from the acid aniline salt, from ligroin. The solution, on cooling, deposited large white plates, but as they were mixed with yellow needles, and as no satisfactory way could be found to separate the two compounds, no analyses were made. It melts at 160°—162°, and is insoluble in dilute chlorhydric acid.

The yellow compound may be obtained in a pure state by heating three parts of acid in sixty parts of water and 2·2 parts of base for about half an hour, and filtering hot from the reddish yellow precipitate. This was extracted with a small amount of hot alcohol that dissolves some of the substance and most of the dark impurities. The residue was purified by three crystallisations from hot alcohol.

0·1949 grm. substance dried at 100° gave 0·1066 grm. AgBr.

0·2285 grm. substance dried at 100° gave 0·1260 grm. AgBr.

	Theory for $\begin{matrix}CNHC_6H_5—CO\\ \vert\\ CBr\end{matrix}\!\!>\!\!\begin{matrix}\\ —CO\end{matrix}\!\!>NC_6H_5$.	Found.	
Br	23·29	23·32	23·46

The anil crystallises from alcohol as flat prisms with end-faces generally at right angles, but in some crystals they obliquely truncated the sides. They melt (under decomposition) at 182°—183°. When large the crystals have a reddish yellow colour, but as a powder or as very small crystals it is almost pure yellow. They are insoluble in hot water, and only moderately soluble in hot alcohol. Dilute chlorhydric acid and dilute alkalies do not dissolve them.

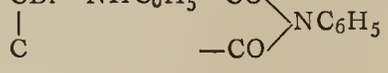
$$\begin{matrix}CBr—COONH_3C_6H_5\\ \vert\\ CBr—COONH_3C_6H_5\end{matrix} + NH_2C_6H_5 =$$

$$\begin{matrix}CNHC_6H_5—CO\\ \vert\\ CBr\end{matrix}\!\!>\!\!\begin{matrix}\\ —CO\end{matrix}\!\!>NC_6H_5 + 2H_2O + C_6H_5NH_3Br.$$

The formation of this substance is of interest because it shows that dibrommaleic acid can hardly have the commonly accepted constitution. If both the bromine atoms were united with the same carbon there is every reason for supposing that a substance free of halogen

* *American Chemical Journal*, Vol. ix., No. 3.

would have resulted from the reaction, as the compound



would, judging from what we know of the properties of this class of substances, hardly show the stability of the substance in question, but would decompose into a substance free of halogen and bromhydric acid.

A substance free of halogen and crystallising as dark red plates may be obtained by heating the acid in aqueous solution with a large excess of aniline. I did not succeed, however, in getting it into a state suitable for analysis.

Behaviour of Bromcitraconic Acid towards Aniline.

Bromcitraconic anhydride (melting-point 99°—100°) was dissolved in twenty parts of water, and an equivalent of aniline added to the solution. The base dissolved and a crystalline precipitate was immediately deposited. This substance was filtered, washed with water, and analysed.

0·2461 grm. substance dried in vacuum gave 0·1556 grm. AgBr.

	Theory for $CH_3—C(CBr—COONH_3C_6H_5)—COOH$.	Found.
Br	26·91	26·50

The acid aniline bromcitraconate crystallises in clusters of small white rhombic plates that melt at 120°—121°, turning yellow. It is soluble in dilute chlorhydric acid, but careful neutralisation of the solution with ammonia throws down the original substance. It is somewhat soluble in cold water.

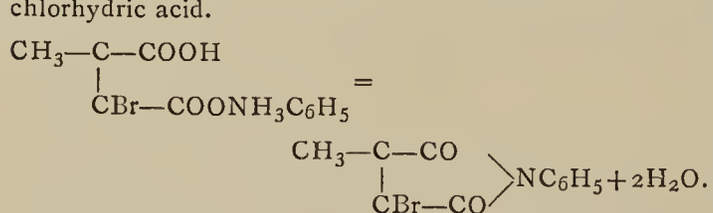
If this salt is allowed to stand under water for a few hours, or its solution in water heated for a minute, it passes over into the anil.* The substance was purified by crystallisation from alcohol.

0·2630 grm. substance dried at 100° gave 0·1871 grm. AgBr.

0·3071 grm. substance dried at 100° gave 0·2197 grm. AgBr.

	Theory for $CH_3—C(CBr—CO)(>NC_6H_5)—CO$.	Found.	
Br	30·07	30·26	30·41

It crystallises in stellar groups of prismatic needles that melt at 144·5°—145·5°, and are insoluble in cold, slightly in warm water. They are readily soluble in hot, moderately in cold alcohol, and are insoluble in dilute chlorhydric acid.



(To be continued.)

City and Guilds of London Institute.—Technical College, Finsbury.—The Annual Students' Conversazione will be held on Friday, May 25th, 1888, commencing at 7 p.m. A lecture will be delivered by Professor S. P. Thompson on "Polarisation of Light," and a lecture will also be delivered by Professor J. Perry, on "Magnifying Springs." A Concert will be given during the evening, and there will be an Exhibition of Drawings, Apparatus, &c. Tickets may be obtained from the Office of the College, or from the Hon. Secs., Messrs. W. D. Conning and P. V. McMahon.

* Through a mistake on my part this substance was represented as the acid anilide in the preliminary note, *Berichte*, xix., 1373.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, May 3rd, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Certificates were read in favour of Messrs. Joseph Campbell, Glen Innes, New South Wales; John Dunn, Myrtle Cottage, Downfield, Dundee; William Burns Featherstone, Showelhurst, Moseley, Birmingham; Albert L. Guiterman, Ph.D., 36, Primrose Hill Road; James C. Hamilton, King's Cavil, Linlithgow, N.B.; James Mair, B.Sc., 181, Hospital Street, Glasgow, S.S.; Edward William Alfred Augustine Mayhew, Freemantle, Western Australia; John James Morgan, Highfield House, Ebbw Vale, Monmouth; Frederick Ernest Pollard, Administration des Services Sanitaires et d'Hygiène Publique, Cairo, Egypt; Albert John Sach, Goulburn, New South Wales, Australia; Mark S. Wade, M.B., Clinton, British Columbia.

The following papers were read:—

36. "*The Determination of the Molecular Weights of the Carbohydrates.*" By Horace T. Brown and G. Harris Morris, Ph.D.

The molecular weights of the carbohydrates have, with one or two exceptions, never been determined with any certainty. The exceptions—dextrose and levulose—have been shown indirectly by Kiliani to have a molecular weight corresponding to the formula $C_6H_{12}O_6$. The generally accepted views with regard to the other carbohydrates are based entirely upon certain indefinite derivatives, and only give the *minimum* size of the molecules. Quite recently V. Meyer (*Ber.*, 1888, 556) and Auwers (*ibid.*, 1888, 860) have drawn attention to the method devised by Raoult for the determination of molecular weights. The method is applicable to all organic substances, and is of especial value in cases where a vapour-density determination is not possible. Blagden, in 1788, established the fact with regard to inorganic salts that the lowering of the freezing-point of their aqueous solutions is proportional to the weight of substance dissolved in a constant weight of water. De Coppet, in 1871-72, extended these results, and pointed out that when the lowering of the freezing-point is calculated for a given weight of the substance in 100 grms. of water, the result, which he terms the *coefficient of depression*, is constant for the same substance, and that the coefficients for different substances bear a simple relation to their molecular weights.

Raoult extended the law to organic substances and to other solvents besides water. He showed that when certain quantities of the same substance are successively dissolved in a solvent upon which it has no chemical action, there is a progressive lowering of the point of congelation of the solution, and this lowering is *proportional to the weight of the substance dissolved in a constant weight of water.* If C be the observed depression of the point of congelation produced by x grms. of the substance dissolved in y grms. of the solvent, then the depression A produced by 1 grm. of the substance in 100 grms. of the solvent is given by the formula—

$$\frac{C \times y}{x \times 100} = A.$$

If the value A, which Raoult designates the "coefficient of depression," of the respective substance for the respective solvent is multiplied by the molecular weight M of the dissolved substance, we get $M \times A = T$, the so-called "molecular depression" of the substance in question. T is a value varying with the nature of the solvent, but remaining constant with the same solvent for numerous groups of compounds. Raoult finds that for

water T = 19 for all organic substances with one or two exceptions. From this it follows that having determined experimentally the value of A for any substance, and knowing the value of T, the molecular weight M for the substance in question may be obtained by dividing A into T: for $M = \frac{T}{A}$.

The method employed by the authors is essentially that of Auwers (*Ber.*, 1888, 712), the solvent employed being necessarily water. The thermometer used is graduated into twentieths of a degree centigrade, and with the aid of a telescope can be easily read to 1-200th of a degree.

The following results were obtained:—

Dextrose. Calculated for $C_6H_{12}O_6$.	Found (mean).
A = 0·106	A = 0·1052
M = 180·0	M = 180·2

Cane-sugar. Calculated for $C_{12}H_{22}O_{11}$.	Found (mean).
A = 0·0555	A = 0·0562
M = 342·0	M = 337·5

Maltose. Calculated for $C_{12}H_{22}O_{11}$.	Found (mean).
A = 0·0555	A = 0·059
M = 342·0	M = 322·0

Milk-sugar. Calculated for $C_{12}H_{22}O_{11}$,	Found (mean).
A = 0·0555	A = 0·055
M = 342·0	M = 345·0

A solution of cane-sugar inverted with *invertase* gave before inversion M = 328, after inversion M = 174·3: clearly showing that 1 mol. of cane-sugar splits up on inversion into two equal molecules.

It was found that dextrose which exhibits birotation in solution has the same molecular weight as dextrose having the normal rotation.

Mannitol. Calculated for $C_6H_{14}O_6$.	Found (mean).
A = 0·104	A = 0·105
M = 182·0	M = 181·0

Arabinose. Calculated for $C_5H_{10}O_5$.	Found (mean).
A = 0·126	A = 0·1263
M = 150·0	M = 150·3

Raffinose. Calculated for $C_{18}H_{32}O_{16}·5H_2O$.	Found (mean).
A = 0·032	A = 0·036
M = 594·0	M = 528·0

All the results are the mean of numerous extremely concordant experiments made with solutions of varying concentration.

All the saccharoses—cane-sugar, maltose, and milk-sugar—were found to have the same molecular weight, thus disproving the suggestions of Herzfeld and others as to their varying values.

The authors have applied the method to starch and the non-crystallisable products of its transformation, but owing to unexpected diffiulties, resulting from the smallness of the value of A for these substances, they are unable as yet to assign accurate values to them, although there can be no doubt that their molecular weights are extremely high.

Numbers confirming this statement are promised for an early meeting of the Society.

37. "*The Molecular Weights of Nitric Peroxide and Nitrous Anhydride.*" By W. Ramsay, Ph.D.

The author has applied Raoult's method of determining molecular weights to nitric peroxide, and has ascertained the depression produced in the freezing-point of pure glacial acetic acid by quantities of peroxide varying from 0·92 grm. to nearly 9 grms. of peroxide to 100 grms. of acetic acid. It is found that in every case the molecular weight of the peroxide is nearly 92, corresponding to the formula N_2O_4; the highest result was 98·58, and the lowest 90·29. These experiments establish the molecular weight of liquid nitrogen peroxide, even in dilute solution, and also show that no further molecular aggregation occurs even when the number of molecules of peroxide in a given volume is considerably increased.

Similar experiments were made with nitrous anhydride, but the temperature of experiment (about 16°) is so high that dissociation occurred during manipulation. No definite results were obtained.

Discussion.

Prof. Debus said he presumed that on dissolving urea in acetic acid combination would occur. Would the molecular weight found be the same if a neutral solvent were used? Also, did not acetic acid act on nitrogen tetroxide? Most liquids exerted a decomposing action on this substance. He was under the impression that Raoult's method involved the use of a solvent which had no chemical action on the substance.

Mr. Wynne remarked that the molecular weight of acetic acid determined by Raoult's method accorded with the formula $C_2H_4O_2$. Now it was known that the vapour-density of acetic acid at a few degrees above its boiling-point pointed to the formula $C_4H_8O_4$, and that it was only at higher temperatures that the less complex molecule $C_2H_4O_2$ was obtained. It must therefore be assumed that the action of the solvent resulted in the complete dissociation of the complex molecules present in liquid acetic acid. Most results hitherto obtained by the use of Raoult's method pointed to a similar complete dissociation, and would seem to show that the dissociation is not dependent on the particular solvent employed, but took place in all cases; the method, therefore, had so far failed to afford any indication of the molecular complexity of liquids and solids.

Referring to the formula $C_{12}H_{22}O_{11}$ deduced by Messrs. Brown and Morris by Raoult's method, Mr. Wynne asked what interpretation was to be placed on the results recently obtained by Winter in his investigation of the specific rotatory power of levulose and of invert sugar, which pointed to the presence in the latter of 3 mols. levulose and 4 mols. dextrose. If these results were accepted it would seem reasonable to suppose that the complexity of the molecule of cane-sugar was greater than that indicated by the formula quoted.

Dr. Perkin said that he had obtained results confirmatory of those brought forward. Using acetic acid as solvent, the molecular weight of naphthalene was found to be 134, and the values he had obtained for the isomeric citraconic, itaconic, and mesaconic acids were respectively 130·6, 130·9, and 138, the calculated value for the simple formula $C_5H_6O_4$ being 130.

Mr. Crompton observed that great irregularities were manifest on comparing the molecular depressions of various substances as determined by Raoult; therefore, until more was known of the cause of such irregularities and of the mechanism of the changes under discussion, such results as those brought forward by Messrs. Brown and Morris must, he thought, be accepted with great reservation.

Dr. Armstrong said that the results obtained by Raoult's method were certainly very striking, but bearing in mind the complexity of the phenomena of dissolution, as there was undoubtedly much evidence to favour the conclusion that the molecules of many substances in the solid and even in the liquid state were congeries of the *fundamental* molecules, he was not prepared to accept the conclusions arrived at as in any way final. If Winter's results were accepted it would be difficult to reconcile them with the conclusion that cane-sugar was represented by the simple formula $C_{12}H_{22}O_{11}$. Apart from the in-

formation as to the comparative molecular weights of dissolved substances which Raoult's method promised to afford, it appeared that in order to gain as complete insight as possible into the molecular composition of solids and liquids it was important to vary in every way the proportions of substance dissolved as well as the solvent: he therefore regarded V. Meyer and Auwers' recent recommendation of acetic acid as the solvent as most unfortunate.

Mr. Heron doubted the correctness of Herzfeld and Winter's determinations of the rotatory power of levulose.

Mr. Brown agreed with Mr. Heron that Winter's statement regarding levulose required confirmation. The values obtained by Raoult were remarkably uniform for members of a group of compounds, and he was of opinion that the general consistency of the results obtained in the case of organic compounds was such as entirely to justify the claim that the results put forward by Mr. Morris and himself were to be accepted as expressing the facts.

Prof. Ramsay asked, Was urea acetate known? [Beilstein does not mention it, although he describes the trichloracetate. Gmelin says that the lactate cannot exist, and states that urea does not combine with weak acids. Moreover, its formation would not materially affect the result, as it would only be equivalent to the withdrawal of a small portion of the acid.] N_2O_4 was without action on acetic acid; it, however, served as a most delicate test of water, a green colour being produced if water were present in the acid. He agreed that as great a variety of solvents as possible should be used.

38. "*The Action of Heat on the Salts of Tetramethylammonium.*" By A. Th. Lawson, Ph.D., and Norman Collie, Ph.D., F.R.S.E.

The research was undertaken to ascertain how the tetramethylammonium salts would behave when heated, and in what respects they would resemble the phosphonium and sulphine compounds. Most of the salts experimented with were found to be very deliquescent and far more soluble than the corresponding ammonium salts, and when compared with the ammonium salts the order of solubility seemed in some cases to be reversed: in the case of the halogen salts the iodide is least soluble, the chloride and fluoride the most soluble. The oxalate and sulphate are extremely deliquescent, while the nitrate is one of the least soluble of the tetramethylammonium compounds and scarcely deliquescent. Nearly all the salts experimented on split up in a simple manner, trimethylamine and a salt of methyl being produced. The fluoride is an instance: $(CH_3)_4NF=(CH_3)_3N+CH_3F$. But in some cases where the decomposition takes place at a high temperature and the methyl salt which is formed is not very stable, further decomposition occurs: of this kind of decomposition the nitrite is an example:—

$$4(CH_3)_4N\cdot NO_2=4(CH_3)_3N+2(CH_3)_2O+4NO+O_2.$$

39. "*The Action of Heat on the Salts of Tetramethylphosphonium.*" By Norman Collie, Ph.D, F.R.S.E.

The action of heat on the salts of tetramethylphosphonium was studied, partly to complete a series of experiments which had been made on the mode of decomposition of the phosphonium salts when heated, and partly to compare their decomposition with that of the tetramethylammonium salts when similarly treated.

The salts of tetramethylphosphonium with the oxyacids, when subjected to the action of heat, undergo, as a rule, two different changes: the first, and by far the most important, is the production of trimethylphosphine oxide and a ketone—in the case of the benzoate:—

$$(CH_3)_4PCO_2C_6H_5=(CH_3)_3PO+CH_3\cdot CO\cdot C_6H_5.$$

The second change, and one which only occurs to a very limited extent, is when trimethylphosphine and a salt of methyl are produced:—

$$(CH_3)_4PCO_2C_6H_5=(CH_3)_3P+C_6H_3\cdot CO_2C_6H_5.$$

As regards the action of heat on the hydracid salts, the chloride is the only one which decomposes in a simple manner:—$2(CH_3)_4PCl=2(CH_3)_3PHCl+C_2H_4$.

Anniversary Meeting, March 28th, 1888.

Address of the President, William Crookes, F.R.S.*

On occasions like the present not a few of my predecessors have laid before the Society able and instructive surveys of the progress of chemical research, discovery, and invention. For two reasons I find myself debarred from following their example.

Of late we have been favoured with such plentiful summaries of advances in every department of Science that I feel unwilling to add to the number, lest I might be accused of producing an *Ilias post Homerum*.

And secondly, although a great quantity of sound and useful work has indeed been done since our last anniversary, yet with two exceptions—I fear I must say incomplete exceptions—we have not witnessed the dawn of any epoch-making, far-reaching discovery which opens out new and tempting prospects of truth. The two exceptions which I have ventured to call partial or incomplete, because they have not yet been fully verified, are the researches of Messrs. Krüss and Nilson on the so-called rare earths, and the investigations of Professor Grünwald of Prague. The result reached by Professor Grünwald in his mathematical discussion on certain spectral revelations seems at least to foreshadow the conclusion that hydrogen, oxygen, carbon, and magnesium are not simple bodies, but compounds. If the phenomena he records admit of no other explanation, and if no unexpected source of error is detected, we may consider ourselves to be within measurable distance of a truly "new chemistry." But here time must decide. Objections already have been raised to the conclusions of Professor Grünwald, and we are forewarned we must not allow ourselves to be carried away by our hopes and our sympathies.

To one event I must beg to draw particular attention,—the tardy justice accorded to Mr. J. A. R. Newlands, the painstaking discoverer of the periodic law of the Chemical Elements. Of the importance of this law it is utterly needless to enlarge. It has been universally accepted as a most valuable generalisation, as the grandest step in theoretical chemistry within the last quarter of a century. Mr. Newlands formulated and published this law in all its main features as early as 1864 and 1865, and was only ridiculed for his pains; yet four or five years later, when Professor Mendeléeff announced the same idea it was received as an original discovery. Original it was in the sense that Professor Mendeléeff was perfectly ignorant of what had been done by Newlands. The strangest thing in this curious history is the fact that in 1882 the Royal Society awarded "Davy Medals" to Professors Mendeléeff and Lothar Meyer, wholly ignoring the prior claims of Mr. Newlands. By degrees, however, the truth became known; and the prior claim of Mr. Newlands was admitted in Miller's "Elements" in 1878, whilst Dr. Tilden accepted it in his "Chemical Philosophy" in 1880, and Dr. Gladstone in his Presidental Address to the Chemical Section of the British Association in 1883. Mr. Newlands reprinted his original papers on this subject in 1884, giving the date of each paper. At length, in November last, better late than never, he received from the Royal Society the well-earned award of the Davy Medal. It would be unpardonable to overlook the energetic action of Professor Frankland in bringing about the recognition of Mr. Newlands' claims. He drew up a lucid and compact statement of the case, with all the necessary evidence, and appended the opinions, published and written, of many of the most eminent chemists.

Now this episode in the history of chemical discovery appears to me to convey a lesson worth noting. We see

* From the *Journal of the Chemical Society* for May, 1888.

that it is possible for an important discovery, even after full and formal publication, to be so thoroughly overlooked and forgotten, that when the same idea some years later is evolved by another and independent inquirer it passes as a striking and novel revelation.

Other occupants of the chair I have now the honor to fill have of late years discussed the position and prospects of scientific, technical, and especially of chemico-technical education. This is, doubtless, a most weighty subject. Seeing the multitude of chemical manuals we have produced, the schools and colleges and classes we have opened, and in particular the examinations we have instituted, we may fairly ask whether our returns of chemical discoveries and inventions are commensurate with all this stir and activity. Our chemical industries, we admit, are by no means in a satisfactory position. We know what systems of training prevail in the countries whose competition we have most cause to fear. We are perfectly aware in what respects these systems differ from our own. But, I may ask, what probability is there, after gleaning hints from our rivals, that we shall lay aside, or even modify, the plans we have taken up and so doggedly follow.

I cannot hely quoting here the opinion of an eminent writer in the *Guardian*:—"And yet man, who is so wise and good that he is always saying, like King Alphonso of Castile, 'Had we been consulted on the creation of the world we could have arranged things better,' has invented competitive examination, which means suffering and pain for all, without even a compensatory 'survival of the fittest' or improvement of the race."

I must notice an unsatisfactory feature in our schools and colleges, to which Mr. Goschen has recently called attention in his inaugural address as Lord Rector of the University of Aberdeen. It is not a flaw in our curriculum or in our method of teaching, but something more deeply seated and less easily remedied. It is the little intellectual interest taken by the students in their studies. Mr. Goschen tells us of the abusive epithets applied in our schools and colleges to pupils who, "not content with doing their work, commit the heinous offence of being absorbed in it."

Now, in this country we have scientific men unequalled in the pure, devoted love of truth, to whom discovery is its "own exceeding great reward." Among the general run of our pupils and students there is, however, little of this enthusiastic temper, and it is, perhaps, on this very account that English educationists think it necessary to offer the stimulus of prizes and certificates, together with other accessories of the competitive system. But do not all these devices tend in the long run to increase that lack of intellectual interest which Mr. Goschen deplores, and are they not sorry substitutes for enthusiasm?

In close connection with the point just discussed there is another subject to which attention may usefully be drawn. I mean the degree of public estimation which chemistry at present enjoys. In his late Presidential Address delivered before the British Association, Sir Henry Roscoe remarked that science was less respected in Britain than in other civilised countries. A variety of facts lead me to suspect that chemistry in this sense is exceptionally unfortunate. For instance, until lately, two of the subjects for the matriculation examination at the University of London were "Natural Philosophy and Chemistry." Recently, by one of those odd alterations so often made in the curriculum of our institutions of higher education, this is changed. The subjects now demanded are—mechanics, which is compulsory for all, and, at option, one of three subjects, chemistry, or one of two departments into which physics is divided. Thus chemistry is no longer deemed indispensable!

It is to be regretted, also, that in the course adopted somewhat recently by certain of the licensing bodies of the medical profession with regard to the requirements of preliminary training in natural science, the candidate is now no longer required to study these branches in a college or school with recognised facilities for chemical or other natural science teaching, but may obtain that instruction from any person. At first sight this may appear to be a broad and liberal measure, but on reflection it is easy to see how such action on the part of licensing bodies is a direct encouragement of the pernicious system of "cram."

It is well known that some of our public schools had begun to introduce physics and chemistry into their ordinary courses, and that other schools were preparing to follow their example. But no inconsiderable check has been given to this reasonable movement by certain changes introduced at the Military School of Sandhurst, and by others about to be adopted in the school for the Royal Engineers and Artillery at Woolwich. According to the new code, whilst as many as 3000 marks each can be earned in Latin, French, and German, and in "compulsatory" and "optional" mathematics, the utmost possible number to be gained in physics and chemistry, which rank as "second class," is 2000 each! Hence the study of these subjects, which are not made compulsory, is heavily handicapped. Even youths possessing exceptional taste and ability for physical science, if they select such subjects, must either fail altogether, or come out lower in the successful list than if they had confined themselves to languages and mathematics. Hence physics and chemistry are much more rarely taken up. Nor does the mischief end here. The public schools which prepare boys for the admission examinations of Sandhurst and Woolwich will of course pay less attention to chemistry and physics, and may not impossibly feel inclined to drop them altogether. As *Nature* puts it:—"Good work in science pays less well than mediocrity in other subjects. The new regulations lower the standard of school work by constantly withdrawing from the science classes a large proportion of the best students." If the new regulations should be introduced at Woolwich, as is threatened, it will be somewhat farcical to speak of the Engineers and the Artillery as the "scientific branches" of the service.

(To be continued).

THE ROYAL SOCIETY.

Amongst other subjects exhibited and illustrated at the conversazione on May 9th, the following are of especial interest to our readers:—

Experiments on the Optical Demonstration of Electrical Stress.—Exhibited by Professor A. W. Rücker, F.R.S., and Mr. C. V. Boys, A.R.S.M.

These experiments are similar to those devised by Dr. Kerr, the arrangements being modified so as to render them suitable for exhibition in public.

Conductors of various forms are immersed in bisulphide of carbon and placed between crossed Nicol's prisms. When the conductors are oppositely electrified the medium is thrown into a state of stress, and the light which had been extinguished by the analysing prism is restored.

The various forms of conductors employed are—

Parallel cylinders, concentric cylinders, parallel planes, a plane and cylinder, and plates bent so as to represent a section of a Leyden jar.

Many of the phenomena exhibited by crystals in plane polarised light are imitated—*e.g.*, the black cross and the production of colours similar to those in Newton's rings. A bright field can be maintained by the introduction of a plate of selenite between the Nicol's, in which case the electrical stress is indicated by change of colour.

Large Electrical Influence Machine.—Exhibited by Mr. James Wimshurst.

It has 12 disks of 2 feet 6 inches in diameter, each disk carries 16 metal sectors. The machine is self-exciting in any condition of atmosphere. It shows large and perfect brush discharge at its terminals. With Leyden jars will give sparks 13⅝ inches in length.

Radio-Micrometer. — Exhibited by Mr. C. V. Boys, A.R.S.M.

This is probably the most delicate instrument for measuring radiant heat yet made. It consists of a circuit made of antimony, bismuth, and copper hung by an exceedingly fine fibre of quartz in a strong magnetic field. A scale model of the circuit, twenty times the size or 8000 times the weight, shows the construction of the suspended part of the instrument. The fibre, if magnified to the same extent, would still be finer than spun glass. The proportions of the several parts are those which have been found by calculation (confirmed by experiment) to give the greatest possible delicacy.

Experiments with Soap-bubbles.—Exhibited by Mr. C. V. Boys, A.R.S.M.

These experiments are arranged to show chiefly the power of an air film to prevent two bubbles from coming into real contact. Thus, among other experiments, the outer of two bubbles may be pulled out until it squeezes the inner one into a long oval, but no real contact takes place. An inner bubble filled with gas will carry up an outer one to which are attached a wire ring and other things without really touching it at all. A bubble will roll down a spiral groove also made of soap film, or jump one or two steps at a time down a spiral staircase made of soap film without touching the spiral film or being injured in the least.

Some of the experiments show the effects of diffusion, of vibration, of magnetism, or of electricity upon bubbles or groups of bubbles.

An Apparatus for Determining the Hardness of Metals or other Substances.—Exhibited by Mr. Thomas Turner, A.R.S.M., F.C.S., F.I.C.

This apparatus is a modification of the sclerometer used in determining the hardness of minerals. A polished surface of the metal or other material to be tested is brought underneath a weighted diamond, which is moved in such a manner as to produce a visible line on the smooth surface. The weight in grms. necessary to produce a standard visible scratch is taken as a measure of the hardness of the material.

A Coulomb Meter.—Exhibited by Prof. George Forbes, F.R.S.

Consists essentially of a conductor of iron wire in the form of a spiral, or a double ring with cross wires. Above the conductor a set of vanes is pivoted. This consists of a circular disc of mica with a hole in the centre in which is fixed a paper cone carrying at its apex a pinion with a concentric ruby cup. Round the circumference of the mica disc eight small cylinders of pith are fixed at equal distances, and eight vanes inclined at 45° to the mica disc are attached to the pith cylinders, these vanes being made of the thinnest mica. This set of vanes is supported by the ruby cup resting on a steel point fixed to the base of the instrument. The pinion engages with the first wheel of a train of wheelwork actuating the indexes, which show upon dials the number of revolutions made by the vanes.

The action of the instrument is very simple. The electric current passing through the iron conductor creates heat, which sets up a convection current in the air, and this causes the vanes to rotate about the vertical axis and drive the clockwork. The number of revolutions indicated on the dials is, through a considerable range of currents, an exact indication of the number of coulombs or ampère-hours which have passed through the conductor. The friction of the ruby cup on the pivot determines the smallest current which can be accurately measured, and the friction of the clockwork is barely perceptible. The resistance of a meter to read from 1 ampère upwards is 0·02 ohm.

The New Iridio Platinum Incandescent Gas Burner (Lewis and Sellon's patents).— Exhibited by Messrs. Johnson, Matthey, and Co.

Apparatus for the Isolation of the Element Fluorine.— Exhibited by Prof. T. E. Thorpe, F.R.S.

(*a*) Apparatus for the preparation of anhydrous hydrofluoric acid by heating acid potassium fluoride.

(*b*) M. Moissan's apparatus for the electrolysis of hydrofluoric acid.

Apparatus for Measuring the Changes produced by Magnetisation in the Dimensions of Rods and Rings of Iron and other Metals.—Exhibited by Mr. Shelford Bidwell, M.A., F.R.S.

The instrument exhibited is capable of measuring changes of length to a millionth of a millimetre or a twenty-five-millionth of an inch.

An *iron* rod when magnetised becomes (as is well known) at first slightly lengthened. But if the magnetising force is sufficiently increased it again contracts, and ultimately becomes actually shorter than when unmagnetised. A *cobalt* rod contracts under magnetisation, reaching a minimum length in a field of about 500 C.G.S. units, beyond which point it becomes longer. A *nickel* rod also contracts; the limit of its contraction not having been reached with the greatest magnetising forces yet used. *Bismuth* is slightly elongated in intense fields. See *Proc. Roy. Soc.*, vol. xliii. (1888), p. 406.

Experiments Illustrating Low-temperature Spectra in Connection with the Spectra of Meteorites.—Exhibited by Mr. J. Norman Lockyer, F.R.S.

(1). Spectra of Mg, Mn, Pb, Fe, Ba, &c., at the temperature of the oxy-coal-gas flame.

The brightest of the lines, bands, and flutings seen under these conditions are those seen in the spectra of uncondensed meteor-swarms (nebulæ, comets, "stars" with bright line spectra, and bodies of Group II.).

The bright edge of the fluting at 500 in the spectrum of magnesium is coincident with the chief line in the nebula spectrum. Usually only the remnant of the fluting is seen, but on one occasion, at Greenwich, it was recorded as a fluting in the spectrum of the Nebula in Orion.

The brightest manganese fluting is at wave-length 558, and the second in intensity is at 586. The latter is seen as a dark band in all bodies of Group II., but the one at 558 is not seen in all of them. In these cases it is marked by the bright carbon fluting beginning at wave-length 564, the second one remaining visible because there is no carbon fluting near it. It may be remarked that the second manganese fluting is the probable origin of the so-called D_3 line in the spectrum of γ Cassiopeiæ, the appearance of a bright line being due to contrast at the darkest edge of the fluting.

The line of manganese at 540 is seen in the spectra of most of the "stars" with bright lines.

Another case of masking is that of barium. The brightest band is at wave-length 515, and the second at 525. In some of the bodies of Group II., only the second band is seen, the first one being masked by the bright carbon fluting at 517.

(2). Photographs of spectra at the temperature of the oxy-coal-gas flame.

The spectra of Mg, Mn, Fe, Pb, Ba, Sr, Ca, Cr, Bi, Cd, and Al, with a comparison spectrum of air and calcium in each case.

(3). Experiment showing the conditions of disappearance of the C and F lines from the spectrum of hydrogen.

The tube exhibited was prepared by putting a small chip of sodium in one of the open ends and sealing off behind it. The other end being connected with a Sprengel pump, the tube was exhausted and the sodium gently warmed. After further exhaustion the pump was stopped, and under these conditions C and F were visible. The sodium being again heated, C and F gradually dimmed, and the structural spectrum of hydrogen appeared, the colour changing from red to blue. When C and F had disappeared the tube was sealed off. Under present conditions C and F are not seen in the spark without jar, but on putting the jar in the circuit they make their appearance. The condition for the absence of C and F

is that of maximum conductivity. The fact that the structure-spectrum can be derived from the ordinary spectrum, and vice-versa, proves it to be a true spectrum of hydrogen, and not an impurity spectrum.

The structure spectrum is of interest in connection with the meteoric hypothesis, inasmuch as some of the lines are apparently coincident with lines in the spectra of some of the "stars" with bright lines. But since some of the strongest lines are absent from the spectrum of the "stars" the coincidences are very probably accidental.

(4). Map of meteorite spectra at the temperature of the oxy-coal-gas flame.

The spectra of the flames of 16 meteorites have been observed, and on the map they are arranged in order, beginning with the irons and passing gradually to the most stony ones. Only lines of Fe, Mn, Na, K, Li, and Cu, and two flutings, one of iron, and one of manganese, are seen.

(5). Photographs of some of the meteorite flames are also exhibited, but at present the series is incomplete.

(6). Photograph of a composite spectrum of meteorites compared with the solar spectrum.

Two pieces of the Nejed meteorite were bound with wire to the two carbons of an arc lamp, so that they served as poles. A mixture of meteorites, both iron and stony, was then made, and a small quantity put on the lower pole. The plate being exposed, the current was made to pass and the spectrum photographed. One half of the slit was exposed to the meteorites, and the other half to the sun.

Exhibited by Mr. W. C. ROBERTS-AUSTEN, F.R.S.:—

Specimens of Gold showing the effect of small quantities of impurity on the fracture of the Metal.

Exhibited by the WOODHOUSE and RAWSON ELECTRIC SUPPLY COMPANY:—

Vernon Harcourt's New Pentane Standard Lamp.

New Carbon Microphone Button.

Samples of "Adamantine" Carbon.

New Chemical "Pole Indicator."

Holophotometer for measuring the intensity of a light all round.

Exhibited by the EDISON and SWAN UNITED ELECTRIC LIGHT COMPANY:—

Edison and Swan Company's Safety Lamp for Miners.

The lamp consists of a storage battery of four cells enclosed in a strong teak box turned out of the solid and strengthened with metal bands; and a small Incandescent Lamp mounted on the side of the case, protected by a strong glass cover. The case is fitted with a hinged lid secured by a crossbar fastened with a safety-nut, and having a swivel handle.

The full size of the lamp is 7 inches by 4¼ inches, and the weight of the whole ready for use is about 7 lbs.

(1.) Lamp ready for use.

(2.) Battery withdrawn from the case, consisting of four cells or accumulators joined in series, the terminals being brought down the sides of the battery in the form of two contact plates which, when the battery is put into the case, make contact with two corresponding plates inside the case, and so convey the current from the battery to the small Incandescent Lamp.

(3.) Frame in which the battery stands while being charged with current from the Dynamo.

(4.) Hook for lifting out the battery.

(5.) Key for unlocking the nut.

(6.) Screwdriver used to remove the glass cover when replacing the Incandescent Lamp.

(7.) Pipette for filling the battery with acid.

(8.) Lamp with Fire-Damp Indicator attached.

Exhibited by the SCHANSCHIEFF ELECTRIC LIGHT AND POWER COMPANY:—

Miners' Electric Safety Lamps.

(1). A three cell lamp capable of giving 1½ candle power for nine hours. Each cell contains 5 fluid ozs. of solution and consumes ⅝ lb. of zinc in forty-eight hours. The light is more than four times more powerful than that of the Clanny oil lamp, and its working cost is ⅝d. per shift of nine hours, or 3⅜d. per week. The weight when fully charged is about 3¼ lbs. The elements consist of carbon and zinc, and the excitant is a mercurial solution of Mr. Schanschieff's invention.

(2 and 3). Four-cell batteries, one round and one square. Each cell contains 5 fluid ozs. of solution, and at a cost of 1d. furnishes a light of nearly 2 candle power for nine hours. The weight when fully charged is 4½ lbs.

(4). A 4 cell reversible battery, *i.e.*, put in or out of action by reversing it. The charge consists of 24 ozs. of solution. and giving a light of 2 candle power will burn from ten to twelve hours at a cost of 1d.

The batteries can be used for many purposes other than mining lamps, viz., for microscopical purposes, house lighting, photography, diving, railway lighting, gun firing, gas works, &c.

OBITUARY.

THE LATE PROFESSOR WROBLEWSKI.

WE regret that we have to record the death of Dr. Sigmund Wroblewski, the Professor of Experimental Physics at the University of Cracow. While working in his laboratory, the late Professor was severely burnt through the accidental upsetting of a petroleum lamp, and unfortunately the wounds which he then received have been the cause of his lamented decease. Dr. Wroblewski was born in the year 1848, and studied first in the University of St. Petersburg, and subsequently continued his investigations at Strasburg. In 1882 he was appointed to the Chair of Experimental Physics in the University of Cracow, and has, since then, contributed considerably to our knowledge of the subject of the liquefaction of the permanent gases, and the behaviour of substances under high pressures and low temperatures. The valuable supplement to the work of Cailletet and Pictet, which is due to the labours of Professor Wroblewski, cannot be easily estimated, and we deplore the occurrence of the fatal accident which robs the scientific world of such an able experimentalist in this important department of chemistry.

By his earlier experiments on the liquefaction of the permanent gases he was able to determine the critical temperatures and pressures of oxygen and nitrogen, and also from his researches on the absorption of gases by liquids under high pressures proved that carbonic acid did not form the hydrate, $CO_2.H_2O$. In conjunction with Dr. K. Olszewski, he extended his investigations to a study of the behaviour of carbon bisulphide and alcohol at low temperatures, and succeeded in solidifying both these liquids. Nitrogen and carbon monoxide were liquefied under conditions similar to those employed in the case of oxygen, but liquefaction was attended with greater difficulty. By the rapid ebullition of liquid oxygen a temperature of about $-186°$ was obtained, and at this temperature the sudden expansion of compressed nitrogen caused it to form snow-like crystals, and hydrogen, at the same temperature, under a pressure of more than 100 atmospheres, was also obtained in the liquid condition. The low temperatures observed when these gases boil were registered by the aid of a galvanometer and a thermo-electric couple, and by their use he determined the boiling-points of the liquid nitrogen and hydrogen under known pressures. The insulating properties of liquid oxygen and nitrogen were recorded in a paper communicated to the *Comptes Rendus* in 1885, and in the following year he succeeded in determining the density and properties of liquefied air, and established the fact that atmospheric air, when in the

liquid state, behaves as a mixture. The atomic volumes and the densities of these gases were also first accurately determined by Professor Wroblewski, and his results have since been confirmed by more recent observers. The theoretical questions which arise out of researches of this nature also claimed his attention, and in a long paper published last year in the *Annales Phys. Chem.* he proposed that the relation of the physical properties of gases and liquids should in future be represented by curves showing the rate of change of pressure with temperature for different densities instead of by isothermal lines. These curves he called "isopyknics," and from inspection of the diagram of such "isopyknics" new and important conclusions were deduced. In diagrams of this nature the expansion of the substance by heat, and its compressibility, are expressed by the passage from one isopyknic to another either in a vertical or horizontal direction. This method of representing the phenomena accompanying the change of state of substances must therefore also be associated with the important experimental work by which the name of Wroblewski will be remembered.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 18, April 30, 1888.

Determination of the Combustion-heats of the Isomeric Acids, corresponding to the Formulæ $C_4H_4O_4$ and $C_5H_6O_6$.—W. Louguinine.—The author concludes that the constitution of the fumaric and maleic acids must be very different. Fumaric acid is the lower homologue of one of the three acids $C_5H_6O_4$, the formulæ of which must approximate very closely among themselves. The difference in this case is of quite another order from that between the formulæ of the fumaric and maleic acids.

Formation of Hydrates of Gases. — Bakhuis Roozeboom.—The author agrees with MM. de Forcrand and Villard on the interpretation of their results (*Comptes Rendus*, cvi., pp. 849 and 939), but he cannot consider the formation of the hydrates of gases in solutions is still unsolved.

The Slow Combustion of Certain Organic Matters. Th. Schlœsing.—The author concludes that, as it might be expected, the combustion of organic matter, *e.g.*, tobacco, accumulated in aërated masses, begins under the influence of living organisms. Between 40° and 50° this action ceases, and is succeeded by a purely chemical action, which is perceptible at 40°, and goes on increasing rapidly with the temperature.

Detection of Impurities in Alcohols.—X. Rocques.—The author compares the process of M. Savalle, which was indicated some years ago, with that proposed by M. Godefroy in *Comptes Rendus*, April 3rd, 1888. He concludes that pure benzene does not modify the Savalle test. Impure benzene (the so-called pure benzene of commerce) intensifies the reaction of the aldehyds. This fact would be of value if applied to the higher alcohols which we have no easy means of detecting. It is less interesting for the aldehyds which we can detect and even estimate by means of rosaniline bisulphite. In presence of aldehyds it is no more possible to distinguish the higher alcohols by the process of M. Godefroy than by that of Savalle. The aldehyds, by their intense colouration, mask the reaction of the alcohols. In the absence of aldehyds the process is not more sensitive than that of Savalle.

NOTES AND QUERIES.

Action of Light on Selenium.—Will any of your correspondents kindly give me particulars of the action of light on selenium, or inform me where I can obtain such information?—C. GRANVILLE WOOD.

MEETINGS FOR THE WEEK.

TUESDAY, 22nd.—Royal Medical and Chirurgical, 8.30.
—— Royal Institution, 3. "Conventions and Conventionality in Art," by Sidney Colvin, M.A.
WEDNESDAY, 23rd.—Geological, 8.
—— Society of Arts, 8.
THURSDAY, 24th.—Royal Institution, 3. "The Growth and Sculpture of the Alps," by Professor T. G. Bonney, D.Sc., LL.D., F.R.S., &c.
FRIDAY, 25th.—Quekett Club, 8.
—— Royal Institution, 9. "Personal Identification and Description." by Francis Galton, M.A., F.R.S.
SATURDAY, 26th.—Royal Institution, 3. "The Later Works of Richard Wagner," by Carl Armbruster.
—— Physical, 3. "Note on the Governing of Electromotors." by Prof. W. E. Ayrton, F.R.S., and Prof. J. Perry, F.R.S. "On the Formulæ of Bernouilli and Haecker for the Lifting Power of Magnets." by Prof. S. P. Thompson, D.Sc. "Experiments on Electrolysis. Part II. Irreciprocal Conduction," by Mr. W. W. Haldane Gee and Mr. H. Holden.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1487.

MAGNETIC QUALITIES OF NICKEL.*

By J. A. EWING, F.R.S., Professor of Engineering, University College, Dundee, and G. C. COWAN.

The experiments described in the paper were made with the view of extending to nickel the same lines of enquiry as had been pursued by one of the authors in regard to iron (*Phil. Trans.*, 1885, p. 523). Cyclic processes of magnetisation were studied, in which a magnetising force of about 100 c.g.s. units was applied, removed, reversed, again removed, and re-applied, for the purpose of determining the form of the magnetisation curve, the magnetic susceptibility, the ratio of residual to induced magnetism, and the energy dissipated in consequence of hysteresis in the relation of magnetic induction to magnetising force. Curves are given, to show the character of such cycles for nickel-wire in three conditions: the original hard-drawn state, annealed, and hardened by stretching after being annealed. The effects of these have also been examined, —(1) by loading and unloading magnetised nickel-wire with weights which produced cyclic variations of longitudinal pull, and (2) by magnetising while the wire was subjected to a steady pull of greater or less amount. The results confirm and extend Sir William Thomson's observation that longitudinal pull diminishes magnetism in nickel. This diminution is surprisingly great: it occurs with respect to the induced magnetism under both large and small magnetic forces, and also with respect to residual magnetism. The effects of stress are much less complex than in iron, and cyclic variations of stress are attended by much less hysteresis. Curves are given to show the induced and residual magnetism produced by various magnetic forces when the metal was maintained in one or other of certain assigned states of stress; also the variations of induced and residual magnetism which were caused by loading and unloading without alteration of the magnetic field. Values of the initial magnetic susceptibility, for very feeble magnetising forces, are stated, and are compared with the values determined by Lord Rayleigh for iron, and the relation of the initial susceptibility to the stress present is investigated. The paper consists mainly of diagrams in which the results are graphically exhibited by means of curves.

NOTE ON SOME CHINESE DYED SILKS.

By Dr. T. L. PHIPSON, F.C.S,
Member of the Society of Chemical Industry.

Many years ago I published some notes on the spectroscopic characters offered by various aniline dyes, and some colouring-matters of flowers (*Journal of the Chemical Society*, 1869, and *Journ. de la Soc. Roy. des Sciences Medicales et Naturelles, Bruxelles*, 1868). These observations convinced me that when the coal-tar colours were obtained we were, for the first time in Europe, put in possession of the very colours by which Nature adorns the flowers. In numerous cases besides those mentioned in the publications just referred to, I have found that the general chemical properties and spectroscopic characters of the flower-colours are identical with those of the coal-tar colours.

It may be remembered by some of my readers that just before the last named dyes came to light the chemical world was intensely interested in a new Chinese green called Lo Kao. It was a magnificent green on silk, and the first that did not appear blue at night. M. Persoz wrote a most interesting and extensive memoir upon it, in fact a considerable volume, with four pieces of dyed silk inserted into the work, as an illustration. I was fortunate enough to receive a copy of this valuable work from the author himself, whom I met in the Rue Bonaparte on the day of its publication.

The Chinese kept the preparation of the Lo Kao a complete secret; the French missionaries and others attempted in vain to discover the nature of it; experiments were made (on certain suggestions received from China) with plants of the genus *Rhamnus*, with the nettle, with certain kinds of berberry, &c., but all failed to produce a dye equal to the exquisite Chinese product, and many of the processes followed were, moreover, most expensive.

Whilst the excitement about the Lo Kao was still running high the accidental discovery of the aniline dyes came upon the scientific world like a clap of thunder, and soon everything connected with Lo Kao and other Chinese dyes was more or less forgotten. I shall never forget the words of Persoz on the day the news was received in Paris. Turning to me he said:—"C'est un de vos Anglais—et c'est simplement en oxydant l'aniline!"

A few years later I was commissioned to write a paper on the aniline dyes for a scientific periodical, which was illustrated with a considerable number of silk specimens, blue, mauve, red, yellow, &c., and a little later still I wrote my little prize essay:—"Sur les Propriétés Optiques, &c.," and a short supplement in the *Journal of the Chemical Society* (1869), comparing the spectra of certain flower-colours with those of the new aniline dyes.

In the course of another year or two I received from Singapore a small parcel of Chinese dyed silks (in skeins), which, when placed side by side with similar skeins produced in England and Germany from the coal-tar colours, it was impossible to distinguish one from the other: there was no mauve, but the blues, the yellows, and the pinks were absolutely similar to those of the magenta series; moreover, the spectroscopic characters of the solutions were also perfectly similar.

These particular specimens of Chinese silks had been dyed, as nearly as could be ascertained, some time previous to the year 1849, and, therefore, long before the coal-tar dyes were known. This circumstance also convinced me that the Chinese "chemists" had, at least in some instances, been *directly to the flowers* themselves for these magnificent colours; and there can be little doubt that there has existed in China, probably for a considerable number of centuries, a kind of practical chemistry, quite empiric (devoid of all theory?), which has produced results as astonishing as those produced centuries ago in physics and astronomy by the same ingenious people.

Dr. G. LUNGE'S IMPROVED NITROMETER.*

Former nitrometers, as well as Bunte's and Hempel's gas burettes, &c., have the following deficiencies.

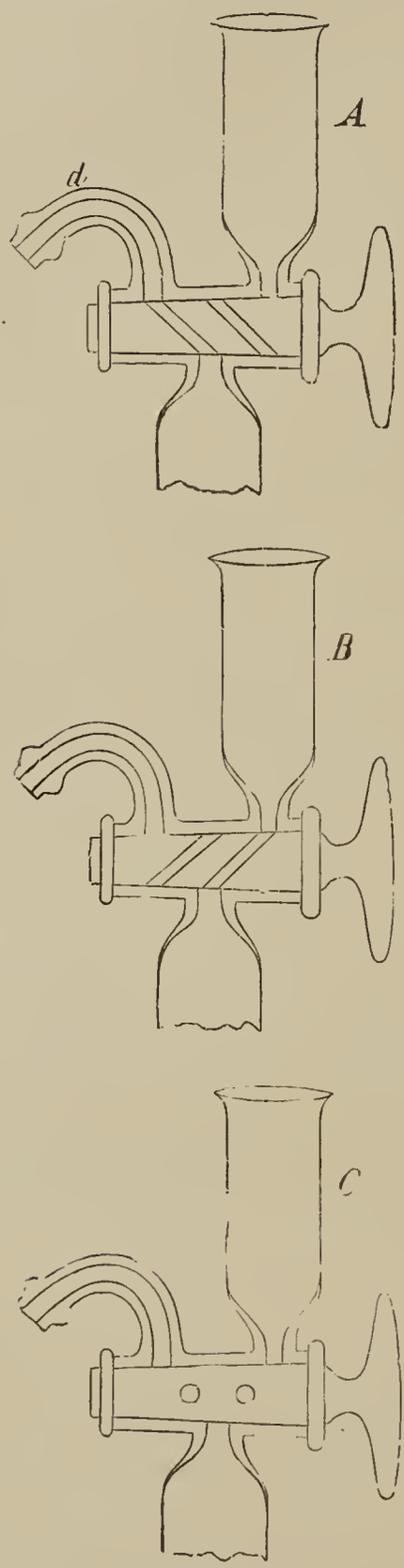
When using these apparatus it is necessary to pay great attention to the three-way stopcock, otherwise a slight overturning of the same will put the analysis in danger. This is to be avoided by using Greiner and Friedrich's new patent stopcocks with oblique borings. Prof. Lunge, the inventor of the nitrometer, recommends the patent stopcocks adapted to his apparatus, as will be seen in the accompanying sketches.

When using the nitrometer for the estimation of saltpetre, dynamite, &c. (whereby the chemical process

* Abstract of a Paper read before the Royal Society, May 18, 1888

* See *Berichte der Deutschen Chemischen Gesellschaft*, 1888 *Chemiker Zeitung*, &c.

takes place in the interior of the apparatus), the stopcock has to be turned like Fig. C, then put the chemicals into the funnel, open the stopcock (like B) and shut the same again (Fig. c). After having finished the analysis the stopcock must be turned to position A, and gas and acid can be removed through the bent tube, D.



This manipulation has the great advantage that the nitrous oxide leaving the bent tube will not be detrimental, while formerly the nitrous oxide and the acid has to be driven back into the funnel, where, exposed to the oxygen of the air, new compounds are created, which had to be removed by means of washing out with water.

When estimating peroxide of hydrogen, chamelion, chloride of lime, manganese, ammonia, urea, carbonic acid, &c., the small decomposing bottle is added to the bent tube, D, in the position A; after that the stopcock is turned for a moment into position B in order to put up the mercury or water to 0°, and turned back to A, after which the analysis can begin.

Another advantage of the improved nitrometer is that the stopper cannot be displaced during the shaking of the decomposing bottle as easily as formerly, as the above-mentioned bottle is independent of the stopper.

The nitrometers, as well as gas-burettes, and other apparatus with patent stopcocks, can be had in London in all sizes at Townson and Mercer's.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON FOR THE MONTH ENDING APRIL 30TH, 1888.

By WILLIAM CROOKES, F.R.S.;
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To GENERAL A. DE COURCY SCOTT, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, May 7th, 1888.

SIR,—We submit herewith the results of our analyses of the 168 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from April 1st to April 30th inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

The whole of the 168 samples examined were clear, bright, and well filtered.

The character of the Thames-derived water supplied to the metropolis, estimated alike by the proportion of organic matter present, the quantity of oxygen absorbable from permanganate, and the degree of colour-tint, has continued through the month of April to correspond very closely with that which prevailed in the preceding month of March. Thus the mean numbers expressing the organic carbon, the oxygen absorbed, and the degree of colour-tint for the month of March, being 0·162, 0·044, and 16·3 respectively, the corresponding numbers for the month of April were found to be 0·164, 0·047, and 15·9 respectively.

In the case of the East London Company's water derived from the Lea, the proportions of organic carbon and of oxygen absorbed, although almost identical with those met with in the water derived from the Thames, were found to be appreciably in excess of the proportions taken note of in last month's report; and a variation in the same direction, though to a smaller extent, was noticeable in the case of the New River Company's water, derived in part from the Lea, and in part from springs.

We are, Sir,
Your obedient Servants,
WILLIAM CROOKES.
WILLIAM ODLING.
C. MEYMOTT TIDY.

RESEARCHES ON ALLOISOMERISM.*

I.

By ARTHUR MICHAEL.

(Continued from p. 196).

Behaviour of Aconitic Acid towards Aniline.

THE importance of the aniline reaction for ascertaining whether an unsaturated polybasic organic acid belongs to the maleic or fumaric acid series is shown when the classification of acids like aconitic, which decompose into simpler products on heating, is in question. That the method based on the formation of anhydrides cannot be used in such cases is obvious; but, as the following experiments indicate, the behaviour of an aqueous solution of the aniline salts of such acids is adapted to show to which series they belong.

An aqueous solution of dianiline aconitate, when boiled in a flask connected with a condenser, soon deposits an oily substance, mixed with some yellow needles. After the formation of the precipitate ceased to increase, it was separated from the mother-liquor and extracted with a little hot alcohol, which dissolved the amorphous substance. The residue was crystallised three times from alcohol.

0·1237 grm. substance gave 0·323 grm. CO_2 and 0·0545 grm. H_2O.

	Theory for $C_{18}H_{14}N_2O_3$.	Found.
C	70·59	71·13
H	4·57	4·91

The substance crystallises in very light yellow fine needles that melt at 250°—252°.† It is insoluble in water, sparingly soluble in hot alcohol. The very small yield of this substance obtained did not permit further examination. It may be identical with the anilide obtained by Pebal‡ by heating aniline aconitate to 140°, as its properties agree with those of the compound obtained by that chemist. The amorphous mass that is the principal product of the reaction could not be brought into a crystalline form. It is insoluble in dilute chlorhydric acid, and is possibly an anilide of the acid.

Far better results were obtained by allowing an aqueous solution of the dianiline salt to remain for some time at ordinary temperature. An amorphous substance also separates in this instance, but in equal quantities a crystalline substance. To separate them the precipitate was extracted with cold alcohol, when most of the amorphous substance went into solution. The residue was then crystallised four times from alcohol.

0·2102 grm. substance, dried at 100° C. in vacuum, gave 0·5134 grm. CO_2 and 0·1028 grm. H_2O.

0·3334 grm. substance, dried at 100° C. in vacuum, gave 23 c.c. N at 765·2 m.m. and 19° C.

	Theory for $C_{18}H_{16}O_4N_2$.	Found.
C	66·69	66·60
H	4·94	5·43
N	8·64	8·15

The substance crystallises in long prismatic needles that have a very faint pinkish cast and melt at 188°—189°. They are insoluble in hot water and dilute chlorhydric acid, but dissolve in alkalies; in hot alcohol they are pretty soluble, moderately in the cold solvent. Strong chlorhydric acid dissolves the substance in the cold, but the addition of water to the solution gives a precipitate of the original substance. The substance is formed from the dianiline salt by elimination of two molecules of water.§

It is evident from these results that aconitic acid belongs to the maleic and not to the fumaric acid series.* I shall return to the importance of this conclusion in regard to the constitution of maleic acid in another paper.

Behaviour of Citra- and Itaconic Acids towards Secondary and Tertiary Aromatic Amines.

According to an observation made by Gottlieb,† an aqueous solution of monoethyl-aniline citraconate can be evaporated to dryness, and the residue heated to melting, without undergoing a change. It will be shown in the following paper that all primary aromatic amines having basic properties give anilides when aqueous solutions of their citraconic acid salts are heated, and it seemed of interest to examine secondary and tertiary aromatic amines in their behaviour towards the new reagent, as a convenient method of separation could probably be based on the results.

A solution of the acid, as well as the neutral, monoethyl-aniline citraconate can be gently warmed without any change, but on boiling the solution it will be noticed that the base is readily given off; in fact, a dilute aqueous solution of these salts when boiled to dryness is free of base, and the residue contains nothing but citraconic acid. The formation of an anilide, when the base was not allowed to escape, was never noticed, although the boiling was continued for a long time and very concentrated solutions were used. It was noticed, however, that solutions of the salts which were clear in the cold gave, on warming, a deposit of methyl aniline; a proof that the decomposition of the salts into base and acid takes place at the temperature of boiling water. Similar experiments were then made with monoethyl-aniline salts, and exactly the same results were obtained. A dilute aqueous solution of the salt when boiled down to dryness is free of base, and a solution made in the cold sets the base free when heated to 100°.‡

The dimethyl- and diethyl-aniline salts of citraconic acid are probably represented by the solutions obtained by saturating a strong aqueous solution of citraconic acid with the bases in the cold, but these compounds are so unstable that dilution suffices to decompose them into base and acid, and by heating the mixtures the base volatilises readily with the steam.

The ethyl derivatives of paratoluidine behaved exactly like the corresponding aniline compounds towards citraconic acid.

To a solution of 2·4 grms. of citraconic acid in 10 grms. of water, 3·4 grms. of diphenylamine were added, and the mixture was then boiled for an hour. On cooling the diphenylamine separated unchanged, and was completely soluble in dilute chlorhydric acid.

As itaconic acid forms only an acid anilide with aniline, it was thought possible that this acid might give an anilide with monomethyl and ethyl-aniline, but experiments showed that it acts exactly like citraconic acid toward these bases.

On these results a method of detecting and separating primary aromatic amines from secondary and tertiary amines was based. It is only necessary to dissolve the basic mixture in a solution of citraconic acid, then add an equal volume of citraconic acid to the solution, and boil in a flask with a reversed cooler for several hours. The flask is then connected with a condenser and the contents rapidly distilled almost to dryness, when, if oil-drops still

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* *American Chemical Journal*, Vol. ix., No. 3.

† In the preliminary note the melting-point of a less pure product was given at 215°—217°.

‡ *Annalen der Chemie*, xcviii., 81.

§ It would be premature to assign structural formulæ to these compounds, although it is very likely they stand in the relation of anilides to the acid. The formation of substances that are insoluble in dilute chlorhydric acid from aqueous solutions of the aniline salt is evidently sufficient to classify the acid as belonging to the maleic series. It is my intention, however, to have these compounds made the subject of a detailed examination.

* I have lately made some aconitic acid by heating the ether with strong chlorhydric acid in a sealed tube at 100°, when the pure acid separates on cooling. This product is quite insoluble in pure ether, while the acid obtained by heating citric acid is generally represented to be very soluble in that solvent. Is it possible that the first product represents the aconitic acid of the fumaric series? The subject deserves further investigation.

† *Annalen der Chemie*, lxxvii., 292.

‡ I am unable to explain the results obtained by Gottlieb with this salt, but suspect that he did not use pure ethylaniline, which, at the time of his experiments, was extremely difficult to obtain in a pure state.

go over towards the end of the operation, more water is added, and the operation repeated. The residue in the flask contains all the primary amines as anilides, and the bases may be obtained as chlorhydrates by decomposing the precipitate with strong chlorhydric acid. If the mixture contains secondary and tertiary amines which are not volatile with steam, the precipitate is treated with dilute chlorhydric acid, when they dissolve, leaving the anilide unchanged. It is not unlikely that the method may be used for a quantitative separation. For detecting a primary aromatic amine a small amount is treated as above in a test-tube, the solution boiled several minutes, replacing the water if necessary, and cooled. If a precipitate is formed that does not completely dissolve in dilute chlorhydric acid, the presence of a primary base may be considered as proved.*

Behaviour of Acetic and Succinic Acids towards Secondary and Tertiary Aromatic Bases.

The results obtained with citraconic acid were the reason for an examination of the behaviour of acetic and succinic acids, as types of fatty mono- and dibasic acids, towards aromatic bases.

Glacial acetic acid and aniline, in equivalent proportions, form, at ordinary temperature, a clear solution of aniline acetate. If this solution is kept under 30° it remains perfectly clear, but above that temperature it begins to become turbid, owing to the separation of minute oil-drops. It increases in turbidity up to 50°, above which temperature it gradually becomes less turbid, and finally perfectly clear at about 60°. On cooling the solution these phenomena are reversed. This remarkable behaviour is evidently due to the presence of a small amount of a base in so-called pure aniline, that has weaker basic properties than aniline itself. This view is corroborated by the following observation. If some water is added to aniline acetate the separation of a small amount of oil takes place, although the solution shows a strong acid reaction. The oil dissolves again when about three times as much water is added as the volume used of aniline acetate.†

An aqueous solution of aniline acetate, when boiled gradually, decomposes, and at first free aniline passes off; after this, a distillate that remains clear on cooling, which, as it contains both base and acid, evidently is aqueous aniline acetate; and finally acetic acid. I have tried a number of aniline salts of volatile fatty acids, and believe that the relation just described may be considered as a general one.

Mono- and dimethyl-aniline, and also the ethyl derivatives, dissolve in the equivalent amount of glacial acetic acid; but it is a matter of doubt whether it is more than simple solution, as the addition of water causes the base to separate. On the differences in their behaviour towards acetic acid a separation of primary amines from the secondary and tertiary bases was based. The basic mixture is dissolved in an excess of glacial acetic acid, three times the volume of water added, the mixture heated, and the oil separated from the solution of primary acetate. It is doubtful, however, whether this method is as exact as the one previously described.‡

Succinic acid (6 grms.) was dissolved in a small quantity of luke-warm water, and methylaniline (5 grms.) added On cooling, most of the base separated from the solution, which was filtered. The solution is clear at ordinary temperature, but becomes turbid, owing to the separation of an oil at about 30°. When boiled, methylaniline escapes leaving a solution of pure acid.

Behaviour of Citraconic Acid towards Fatty Amines.

That the formation of anilides from primary aromatic bases and citraconic acid stands in a close relation to the comparatively weak basic properties of the substances is shown by the behaviour of mono-, di-, and tri-ethylamine citraconates. The acid and neutral salts of these bases may be evaporated to dryness without undergoing any decomposition. A solution of amidoacetic acid in citraconic acid may be boiled without forming an anilide. On evaporating to dryness a residue soluble in water was obtained, but it is uncertain whether it was a citraconate or simply a mixture of the two substances. Aspartic acid does not combine with organic acids.*

(To be continued).

* It is evident that other unsaturated acids, as itaconic or phthalic acids, may be used. I have experimented with citraconic acid, as it seemed best adapted for the purpose, and can be made in large quantities without trouble. It is also apparent that the reaction may be used for detecting acids belonging to the maleic acid series, and in some instances to separate them from other organic acids. With acids like citra-, itaconic, and phthalic, the separation is almost quantitative. There is no doubt that the reaction will prove of considerable use, not only in the investigation of basic aromatic mixtures, but also in studying the decomposition products of organic polybasic acids.

† It is doubtful whether perfectly pure aniline has ever been made. The oil may be amidothiophene, and its investigation is certainly of interest. I shall attempt to obtain it in sufficient amount to ascertain its nature.

‡ This method can of course only be used to separate those primary aromatic amines that form salts with acetic acid.

* The best method of making aspartic acid from asparagine is to boil that substance with alkalies until ammonia ceases to come off, and then acidulate with acetic acid, when all the aspartic acid is precipitated.

† From the *Journal of the Chemical Society* for May, 1888.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 28th, 1888.

Address of the President, William Crookes, F.R.S.†

(Continued from p. 199).

Elements and Meta-Elements.

Permit me, gentlemen, now to draw your attention for a short time to a subject which concerns the fundamental principles of chemistry, a subject which may lead us to admit the possible existence of bodies which, though neither compounds nor mixtures, are not elements in the strictest sense of the word;—bodies which I venture to call "meta-elements."

To explain my meaning it is necessary for me to revert to our conception of an element. What is the criterion of an element? Where are we to draw the line between distinct existence and identity? No one doubts that oxygen, sodium, chlorine, sulphur, are separate elements; and when we come to such groups as chlorine, bromine, iodine, &c, we still feel no doubt, although were degrees of "elementicity" admissible—and to that we may ultimately have to come—it might be allowed that chlorine approximates much more closely to bromine than to oxygen, sodium, or sulphur.

Again, nickel and cobalt are near to each other, very near, though no one questions their claim to rank as distinct elements. Still I cannot help asking what would have been the prevalent opinion among chemists had the respective solutions of these bodies and their compounds presented identical colours, instead of colours which, approximately speaking, are mutually complementary? Would their distinct nature have even now been recognised?

When we pass further and come to the so-called rare earths the ground is less secure under our feet. Perhaps we may admit scandium, ytterbium, and others of the like sort to elemental rank; but what are we to say in the case of praseo- and neo-dymium, between which there may be said to exist no well-marked chemical difference, their chief claim to separate individuality being slight differences in basicity and crystallising powers, though their physical distinctions as shown by spectrum observations are very strongly marked? Even here we may imagine the disposition of the majority of chemists would

incline towards the side of leniency, so that they would admit these two bodies within the charmed circle. Whether in so doing they would be able to appeal to any broad principle is an open question.

If we admit these candidates, how in justice are we to exclude the series of elemental bodies or meta-elements made known to us by Krüss and Nilson? Here the spectral differences are well marked, whilst my own researches on didymium show also a slight difference in basicity between some at least of these doubtful bodies. In the same category must be included the numerous separate bodies into which it is probable that yttrium, erbium, samarium, and other "elements"—commonly so-called—have been and are being split up. Where then are we to draw the line? The different groupings shade off so imperceptibly the one into the other that it is impossible to erect a definite boundary between any two adjacent bodies and to say that the body on this side of the line is an element, whilst the one on the other side is non-elementary, or merely something which simulates or approximates to an element. Wherever an apparently reasonable line might be drawn it would no doubt be easy at once to assign most bodies to their proper side, as in all cases of classification the real difficulty comes in when the border-line is approached. Slight chemical differences of course are admitted, and, up to a certain point, so are well-marked physical differences. What are we to say, however, when the only chemical difference is an almost imperceptible tendency for the one body—of a couple or of a group—to precipitate before the other? Again, there are cases where the chemical differences reach the vanishing point, although well-marked physical differences still remain. Here we stumble on a new difficulty: in such obscurities what is chemical and what is physical? Are we not entitled to call a slight tendency of a nascent amorphous precipitate to fall down in advance of another a "physical difference?" And may we not call coloured reactions depending on the amount of some particular acid present, and varying according to the concentration of the solution and to the solvent employed, "chemical differences?" I do not see how we can deny elementary character to a body which differs from another by well-marked colour- or spectrum-reactions, whilst we accord it to another body whose only claim is a very minute difference in basic powers.

Having once opened the door wide enough to admit some spectrum differences, we have now to enquire how minute a difference qualifies the candidate to pass? I will give instances from my own experience of some of these doubtful candidates.

1. Two closely allied bodies* differ slightly in basic powers and more decidedly also in their spectrum reactions; are they distinct entities? Probably yes.

2. Two bodies† have no distinct spectrum reaction, and differ in basicity so slightly that their separation has hitherto proved to be impossible; but they differ decidedly in the colour of their oxides. Are they different? I should in this case also say "yes."

3. Two bodies‡ obtained from different minerals have no recognisable chemical difference, but there is a strong line in the phosphorescent spectrum of one which is absent in the other. What are we to say in this case?

4. An earth§ separated with enormous difficulty from its associates has a certain very definite phosphorescent spectrum. The addition of another body greatly intensifies one or more of the lines of the spectrum of the earth so separated, while upon the other lines in the spectrum of the same earth it has no action. Is the basis of this earth simple or compound?

5. An earth* showing no difference on fractionation has a phosphorescent spectrum not materially modified by the admixture of another earth; but the residual glow of one part of the spectrum as seen in the phosphoroscope is suppressed, while that of the other is not affected. Are we not here also dealing with more than one sort of molecule?

6. Earths,† apparently the same, from different minerals, behave alike chemically and spectroscopically, with the exception that a certain line in the spectrum of the one is a little brighter than the corresponding line in the spectrum of the other.

Again, where are we to draw the line? If an immediate decision were required, and a poll of the chemists in this room demanded, we should probably find the dividing lines placed in all positions among these seven cases.

But to have only one rank in the elementary hierarchy, to class these obscure and indefinite bodies in the same rank with silver and chlorine and oxygen and sulphur, is as manifest an absurdity as it would be to put a speck of meteoric dust upon a level with the planet Jupiter because both may be called distinct members of the solar system.

Is there no way out of this perplexity? Must we either make the elementary examination so stiff that only some 60 or 70 candidates can pass, or must we open the examination doors so wide that the number of admissions is limited only by the number of applicants?

The real difficulty we encounter by unlimited multiplication of elements arises from the Periodic theory. That theory has received such abundant verification that we cannot lightly accept any interpretation of phenomena which fails to be in accordance with it. But if we suppose the elements reinforced by a vast number of bodies slightly differing from each other in their properties, and forming, if I may use the expression, aggregations of nebulæ where we formerly saw, or believed we saw, separate stars, the periodic arrangement can no longer be definitely grasped. No longer, that is, if we retain our usual conception of an element. Let us then modify this conception. For "element" read "elementary group," such elementary groups taking the place of the old elements in the periodic scheme,—and the difficulty falls away.

In defining an element, let us not take an external boundary, but an internal type. Let us say, *e.g.*, the smallest ponderable quantity of yttrium is an assemblage of ultimate atoms almost infinitely more like each other than they are to the atoms of any other approximating element. It does not necessarily follow that the atoms shall all be absolutely alike among themselves. The atomic weight which we ascribe to yttrium, therefore, merely represents a mean value around which the actual weights of the individual atoms of the "element" range within certain limits. But if my conjecture is tenable, could we separate atom from atom, we should find them varying within narrow limits on each side of the mean.

The very process of fractionation implies the existence of such differences in certain bodies. Until lately such bodies passed muster as elements. They had definite properties, chemical and physical; they had recognised atomic weights. If we take a pure dilute solution of such a body, yttrium for instance, and if we add to it an excess of strong ammonia, we obtain a precipitate which appears perfectly homogeneous. But if instead we add very dilute ammonia in quantity sufficient only to precipitate one half of the base present, we obtain no immediate precipi-

* Erbium and holmium; erbium and yttrium; samarium and didymium, &c.

† The white and yellow components of cerium (*Phil. Trans.*, clxxi. (1885), 704.

‡ Yttrium from samarskite gives the Sδ line, whilst in that from gadolinite this line is absent (*Proc. Roy. Soc.*, xl. (1886), 502—509). The reputed Yα of M. de Marignac contains all the phosphorescent lines of the old yttrium spectrum except the line of Gδ (*Proc. Roy. Soc.*, xl. (1886), 236).

§ The phosphorescent spectra of yttrium and samarium are modified by the addition of various earths in the way here mentioned. Samarium affects the alumina spectrum in a similar manner (*Proc. Roy. Soc.*, xlii. (1887), 111—131).

* Calcium sulphate and many other bodies behave in this manner in the phosphoroscope (*Proc. Roy Soc.*, xlii. (1887), 120).

† Yttrium from different minerals shows great variations of intensities in all its lines. Gζ appears in greater quantity in samarskite than it does in gadolinite (CHEMICAL NEWS, liv. (1886), 157).

ate. If we stir up the whole thoroughly so as to ensure a uniform mixture of the solution and the ammonia, and set the vessel aside for an hour, carefully excluding dust, we may still find the liquid clear and bright without any vestige of turbidity. After three or four hours, however, an opalescence will declare itself, and the next morning a precipitate will have appeared.

Now, let us ask ourselves what can be the meaning of this phenomenon?

The quantity of precipitant added was insufficient to throw down more than half the yttria present, therefore a process akin to selection has been going on for several hours. The precipitation has evidently not been effected at random, those molecules of the base being decomposed which happened to come in contact with a corresponding molecule of ammonia, for we have taken care that the liquids should be uniformly mixed, so that one molecule of the original salt would not be more exposed to decomposition than any other. If, further, we consider the time which elapses before the appearance of a precipitate, we cannot avoid coming to the conclusion that the action which has been going on for the first few hours is of a *selective* character. The problem is not *why* a precipitate is produced, but *what determines* or directs some atoms to fall down and others to remain in solution. Out of the multitude of atoms present, what power is it that directs each atom to choose the proper path? We may picture to ourselves some directive force passing the atoms one by one in review, selecting one for precipitation and another for solution, till all have been adjusted. In order that such a selection can be effected there evidently must be some slight differences between which it is possible to select, and this difference almost certainly must be one of basicity, so slight as to be imperceptible by any test at present known, but susceptible of being nursed and encouraged to a point when the difference can be appreciated by ordinary tests.

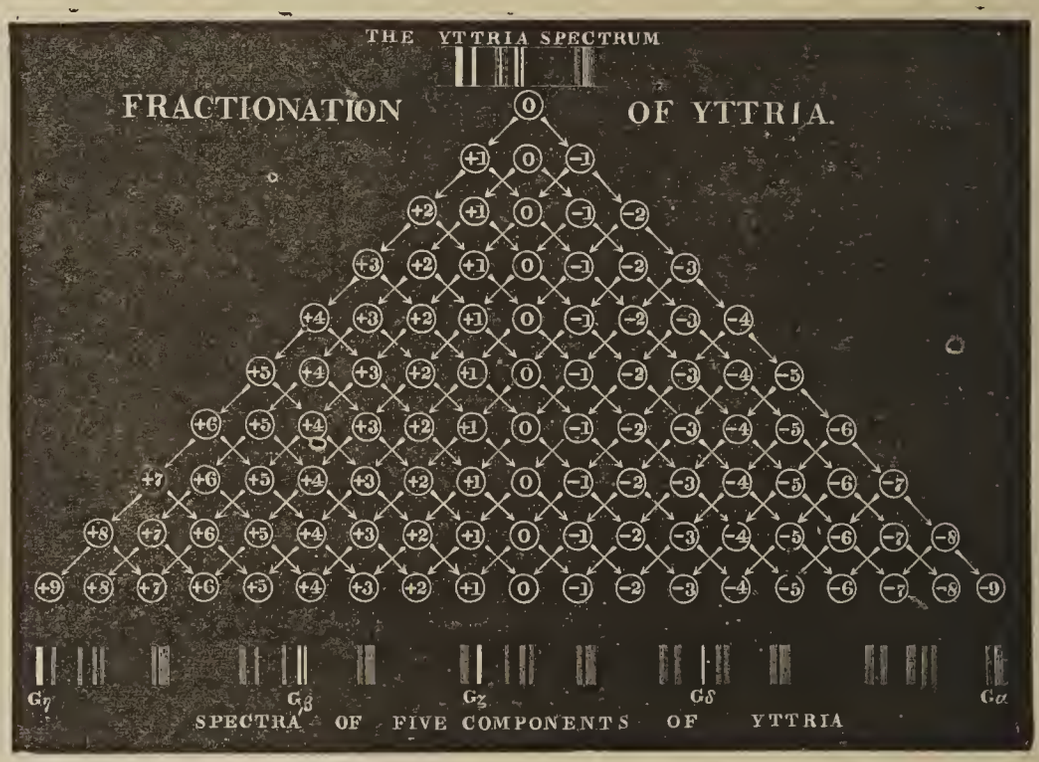
Let us follow our atoms through another stage of fractionation. The ammonia has divided them into two groups, one of which displays just the minutest possible suspicion of greater basicity than the other. Let us repeat the first experiment again with these two groups. Again, we obtain from each a precipitate and a solution, so that we have now two precipitates and two solutions. It is evident that whereas the precipitate from the original salt was slightly less basic than that which remained dissolved, the second precipitate from the first precipitate must have its basic character still further diminished, while at the same time the second solution from the first solution must contain selected atoms of a slightly higher degree o basicity. The least basic at one end and the most basic at the other end are thus two removes each from the original; and treating them in the same way for a third time, we obtain two groups of atoms which are three removes from the centre. (The intermediate groups need not be here discussed. By systematic mixings they can be made to contribute their quota to the end groups.) By repeating this operation, not once or twice but many hundreds of times, those atoms having a tendency to come down first always going one way, and those having a tendency to remain dissolved always going the other way, we, so to speak, *educate* the atoms, adding to them no fresh properties, but drawing out and giving free scope to properties that already existed, but that were previously masked.

A similar absence of absolute homogeneity may possibly yet be traced in many of the "elements" if once the right reagents are selected, and if laborious chemists are to be found willing to devote years to researches barren to outward seeming.

That this deviation from absolute homogeneity should mark the constitution of these molecules* or aggregations of matter which we designate elements will perhaps be clearer if we return in imagination to the earliest dawn of our material universe, and face to face with the great secret, try to consider the processes of elemental evolution.

Going back to the "fire-mist," the "ur-stoff" of the German philosophers, or the "protyle," as, after Roger Bacon, I have ventured to call it, we see an infinite number of immeasurably small ultimate, or rather ultimatissimate particles gradually accreting out of "formless stuff," and moving with inconceivable velocity in all directions. We find those particles which approximately have the same rate and modes of movement, beginning to heap themselves together by virtue of that ill-understood tendency through which like and like come together—

FIG. 1.



* Clerk-Maxwell defines a molecule as "a material system, the parts of which are connected in some definite way. ("Atom," *Encyclopædia Britannica*, 9th Ed., 3, 43.

that principle by virtue of which identical or approximately identical bodies are found collected in masses in the earth's crust instead of being uniformly distributed.

One of the first results of this massing tendency is the formation of certain nodal points in space, between which occur approximately void intervals. How such nodes and spaces come to be formed we shall be better able to understand by a very few simple illustrations, choosing in the first instance, instead of ultimate atoms, living men and women.

If we take any very frequented street in London, say Fleet Street, at a time when the animated current runs pretty equally in two directions, and if our rate of walking is somewhat greater than the mean speed of the other foot passengers, we shall observe that the throngs on the footways are not evenly distributed, but consi t of knots or groups—we might almost say blocks—with comparatively open intervening spaces. The explanation of this unequal agglomeration of individuals is simple. Some two or three persons whose rate of walking is slower than the average somewhat retard the movements of other persons, whether travelling in the same or in the opposite direction. In this manner a slight temporary obstruction is created. The persons behind catch up to the obstruction, and so increase it, while those in front of the obstruction, hurrying on unhindered at their former rate, leave a comparatively free and open space, until they, too, find themselves delayed further on by another little group of loiterers.

The same process may be observed with vehicles in the carriage-way of much frequented streets. Thus we find that differences in rate of movement are sufficient to arrange a multitude of moving bodies into a series of knots and gaps.

In a crowded thoroughfare like Fleet Street, with two opposing human currents, much regularity in the sequence of these knots and voids is not to be expected; but if the observer happens to be walking with a crowd whose constituents are travelling in the same direction, the regularity becomes more apparent; and if, as is sometimes the case, a little rhythm is infused into the steps by an accompaniment of music, the knots and gaps become so orderly that the distance between one block and another, measured in yards, will be found not to differ very greatly from one end of the road to the other.

If, instead of men and women, we experiment with little grains of substances of approximately equal size, but differing in specific gravity, and, mixing them in a horizontal tube, with wa er, we set them in movement by rhythmical agitation, similar phenomena will occur, and the heavy and light powders will sort themselves in a very regular manner.* Descending to a lower degree of minuteness, we all know what occurs when an induction current is passed through a rarefied gas. Here the particles being exempt from free will or caprice, implicitly obey the law I have attempted to illustrate, and out of infinite disorder, under the influence of the electric rhythm, sort themselves into beautiful forms of stratifications.

(To be continued.)

PHYSICAL SOCIETY.

May 12th, 1888.

Professor Reinold, F.R.S., President, in the Chair.

Mr. G. L. Addenbrooke and Mr. H. A. Cunyghame were elected members of the Society.

The following papers were then read:—

"*Note on the Condition of Self-excitation in a Dynamo Machine.*" By Prof. S. P. Thompson, D.Sc.

It is a well-known fact that a series dynamo running at a given speed will not excite itself unless the resistance is less than a certain value, depending on the speed and construction of the machine, and if the resistance is slightly less than this critical value the excitation will not be such as to saturate the magnets. According to the primitive statement of the action of self-exciting dynamos on the "compound interest law" a dynamo should excite itself to saturation at any finite speed, providing the resistance is not infinite. An explanation of the observed facts is given in the paper without any assumption as to the curve of magnetisation. If E = E.M.F. of the machine, n = speed, C = number of wires on outside of armature, N = number of magnetic lines, i = current, S = number of turns on magnet, ΣR and $\Sigma\varsigma$ the sums of the electric and magnetic resistances respectively; then $E = n$CN, $i = n$CN/ΣR, and $N = 4\pi Si/\Sigma\varsigma$. From these it is easily seen that $4\pi n$CS = $\Sigma\varsigma.\Sigma$R,(A), *i.e.*, for a dynamo running at constant speed the product of the magnetic and electric resistances is constant, and the dynamo will not excite itself if ΣR is greater than $4\pi n$CS/$\Sigma\varsigma$. Similarly for a given value of ΣR, excitation is impossible if n is less than $\Sigma\varsigma.\Sigma$R/4πCS. For a value of ΣR less than the critical value the excitation increases until the magnetic restance is increased so that equation (A) is satisfied. The corresponding value for shunt machines is—

$$4\pi n\mathrm{CZ} = \Sigma\varsigma\left\{(r_a + r_s) + \frac{r_a + r_s}{\mathrm{R}}\right\}$$

where Z = number of shunt turns, r_a, r_s, and R the resistances of armature, shunt and external circuits respectively.

In the discussion which followed Mr. Kapp described a method used in testing dynamos, for determining the minimum speed at which dynamos will excite themselves, and from thence determining the magnetic resistance of the air gap. In all cases experiment showed this to be less than the calculated resistance, generally in the proportion of 1500 to 1860, the difference being greater in low tension machines.

Prof. Ayrton pointed out that permanent magnetism was not taken into account, and that the apparent resistances due to self-induction, and between the brushes and commutator, were considerable for small currents.

Lord Rayleigh said Sir W. Thomson had shown critical speeds for given resistances to exist in Faraday's disc dynamo. He (Lord Rayleigh) did not approve of the term "magnetic resistance," and thought "reluctance," as recently suggested by Mr. Heaviside, would be preferable.

"*Note on the Conditions of Self-regulation in a Constant Potential Dynamo Machine.*" By the same author.

In "Dynamo Electric Machinery," a formula—

$$\frac{\mathrm{Z}}{\mathrm{S}} = \frac{r_s}{r_a + r_m}$$

is given as expressing the ratio of the numbers of turns in the shunt and series windings of a compound dynamo. This is on the assumption that there is no saturation within the working limits. As this assumption is not legitimate, a correcting factor is necessary. The factor is shown to be the ratio of the average permeability over the whole working range, to the permeability corresponding with no external current. The formula is transformed so as to be expressed in terms of the "satural" data of the machine, which, as shown in a previous paper can be calculated from its details.

"*On Magnetic Lag and the Work lost due to Magnetic Lag in Alternating Current Transformers.*" By Mr Thomas H. Blakesley, M.A.

* "The atoms run like to like, as you may see either in the case of seeds which are being winnowed in a sieve, or in the case of pebbles on the sea shore; for on account of the whirling of the sieve beans are separated and go with beans, barley with barley, and wheat with wheat; and on account of the motion of the waves, the longish pebbles are driven to the same spot as the longish ones, and the round with the round." Democritus, in a fragment given in *Sextus Math.* (vii., 116 seq.). "The Atomic Theory of Lucretius," by John Masson. 1884, p. 66.

The method adopted to detect the lag is to place dynamometers in both circuits, and one with a coil in each. Then, on the supposition that the E.M.F. of the secondary circuit is entirely due to the changing magnetism of the core, the author proves that the tangent of the magnetic lag angle must be equal to—

$$\frac{\frac{m}{n} C\alpha_3 - B\alpha_2}{\frac{m}{n} \sqrt{(AB\alpha_1\alpha_2 - C^2\alpha_3^2)}}$$

where m and n are the numbers of turns in the primary and secondary coils respectively, A B C the constants of the dynamometers, and α_1 α_2 α_3 their angular reading. A is such that—

$$A\alpha_1 = \frac{I_1^2}{2}$$

where I is the maximum value of the primary current. A table of actual results is given, where the magnetic lag is about 5¼°. The whole power given out by the machine takes the form—

$$r_1 A\alpha_1 + r_2 \frac{m}{n} C\alpha_3$$

where r_1 and r_2 are the resistances of the primary and secondary circuits, while the power lost in hysteresis is expressed by—

$$r_2\left(\frac{m}{n} C\alpha_3 - B\alpha_2\right).$$

The lag is attributed to an induced magnetic stress called into being by the increasing or decreasing magnetism itself, and always opposing it, as motion in a medium induces an opposing force of friction. By supposing such an induced magnetic stress in quadrature (as Mr. Blakesley expresses it) with the magnetism, and of such a value as, when compounded with the stresses due to the currents, shall bring the resultant into quadrature with the secondary current, the effective magnetic stress is obtained. This involves a new idea called Magnetic Self-Induction, with its coefficient. The whole problem is treated by the geometrical method, which the author has applied to several other problems in alternating currents.

Mr. Kapp, Profs. Thompson, Perry, and Ayrton, and Lord Rayleigh took part in discussing the paper.

"*On a Simple Apparatus for the Measurement of the Coefficient of Expansion by Heat.*" By Prof. W. E. Ayrton and Prof. J. Perry, F.R.S.

The apparatus consists of a metal tube within which the wire or rod whose coefficient is to be determined is placed. One end of the wire is rigidly attached to one end of the tube, and the other end connected to an Ayrton and Perry magnifying spring, a pointer attached to which indicates the change of length due to alteration in temperature. Steam or water may be passed through the tube, the temperature of the wire being shown on a thermometer. The arrangement is very sensitive, and with a pointer about 20 c.m. long, the motion is magnified about 1000 times.

A magnifying spring attached to an aneroid was also shown, and its great sensibility demonstrated. A combination of a spring of large diameter and pitch with one of small diameter and pitch was exhibited. By such a combination small rotations can be immensely magnified. The great features of the patent spring as a magnifier are the entire absence of friction and back lash, and the large range of proportionality.

A note on the "*Governors of Electromotors*," by the authors, and one the "*Electrical Action of Light*," by Mrs. W. E. Ayrton, were postponed until next meeting.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, May 7, 1888.

Sir James Crichton Browne, M.D., LL.D., F.R.S., Vice-President, in the Chair.

The following Vice-Presidents for the ensuing year were announced:—

Sir James Crichton Browne, M.D., LL.D., F.R.S.; William Crookes, F.R.S.; Warren de la Rue, M.A., D.C.L., F.R.S.; Colonel James A. Grant, C.B., C.S.I., F.R.S.; Sir Frederick Pollock, Bart., M.A.; John Rae, M.D., LL.D., F.R.S.; Henry Pollock, Treasurer; Sir Frederick Bramwell, D.C.L., F.R.S., Honorary Secretary.

John Hutton Balfour-Browne, Q.C., Lady Roscoe, John Callander Ross, and T. E. Thorpe, Ph.D., F.R.S., were elected Members of the Royal Institution.

Six Candidates for Membership were proposed for election.

John Tyndall, D.C.L., LL.D., F.R.S., was elected Honorary Professor of Natural Philosophy.

The Right Hon. Lord Rayleigh, M.A., D.C.L., LL.D., F.R.S., was elected Professor of Natural Philosophy.

The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

NOTICES OF BOOKS.

Sell's Dictionary of the World's Press and Advertising Reference Book. 1888. By Henry Sell. London: Sell's Advertising Agency, Limited.

A work of this kind is a great convenience, if not a necessity, to numbers of persons in addition to advertisers, and it must be recognised that Mr. Sell has in all probability approached nearer to the ideal of such a compilation than any of his predecessors. In addition to the mere directory of newspapers and journals there is much useful matter. Thus we find almost at the outset a summary of the law of libel, which certainly requires cutting down a good many stages before it can be admitted as satisfactory. At present even the proprietors and conductors of scientific and technical journals, who do not at all concern themselves with personal matters, can never absolutely know when they are safe from litigation and annoyance. Next follow the stipulations of the International Convention on copyright,—an agreement sadly crippled, as far as Britain is concerned, by the non-accession of the United States.

The chapters on the "Rise of Provincial Journalism" and "Notable Press Prosecutions" are too pointedly political to admit of our notice.

The question of "Anonymous Journalism *v.* Personal Journalism" is discussed at some length. Of course in scientific periodicals, where observations and experiments are concerned, the signature of the writer is essential; but wherever the facts are already before the public, as in the discussion of theories and the review of works, anonymous writing has our preference. Where articles in magazines and journals are signed, the public ask not what is said, but who said it, and are apt to ignore the ablest matter from the pen of an unknown writer.

Passing to the Directory itself we must, of course, judge it from the point of view of scientific and technical journalism. This seems to be the least successful department of the "Dictionary." We find some publications of this class wanting which we know to be in existence, whilst at least one is mentioned which has ceased to appear for a couple of years.

If we examine the lists of Continental publications we find a much greater deficiency in the same sphere. Not one of the French scientific journals—some of which are very important—is mentioned. The same is the case

with the German and Italian journals of this class. Hence we must regard the "Dictionary of the World's Press," though undoubtedly useful, as capable of very great improvement.

CORRESPONDENCE.

PRESSURE TUBES.

To the Editor of the Chemical News.

SIR,—Having noticed Mr. H. N. Warren's note entitled "Pressure Tubes, their Use and Construction" (CHEMICAL NEWS, vol. lvii., p. 155), and having lately required a similar tube, I substituted for the magnesia fine iron filings, and with considerable advantage, these being a much better conductor of heat. It may, however, be only just to mention that the tubes prepared according to Mr. Warren's construction will stand an enormous pressure, and it is evident that if Mr. Warren continues his important researches we shall undoubtedly, before long, be in possession of a new chemistry.—I am, &c.,

L. R.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 19, May 7, 1888.

The Acid Phosphites of the Alkaline Metals.—L. Amat.—In a former memoir the author proved the existence of an acid ammonium phosphite. He has now succeeded in preparing the corresponding potassium and sodium salts.

Properties of Sodium Disulpho-persulphate.—A. Villiers.—This salt, when anhydrous, crystallises in orthorhombic prisms. The anhydrous salt is permanent in the air; it fuses at about 125°, and at 140° it swells up, giving off sulphurous acid. The residue is potassium sulphate and sulphur, not accompanied by a sulphide. Its solutions, when mixed with metallic solutions, do not yield precipitates, except with mercuric chloride.

The Crystalline Form of Sodium Trithionate.—A. Villiers.—It crystallises with 3 mols. of water, forming orthorhombic prisms, the measurements of which are given by the author.

On Hydrated Methyl Chloride.—MM. de Forcrand and Villard.—The authors examine and measure the tension of dissociation of this compound. Their results at low and high pressures are given in the form of tables.

On Terpinol.—G. Bouchardat and R. Voiry.—The complex product of the action of alcoholic potassa upon terpilene dihydrochlorate, though in some respects presenting analogies with List's terpinol is essentially distinct. It contains compounds of different chemical functions, but all belonging to the series of terpilene, which is the only definite compound common to the two products.

Moniteur Scientifique, Quesneville. Series 4, Vol. ii., February, 1888.

Detection of Cotton Oil in Olive Oil.—Ernest Milliau.—In a porcelain capsule, holding about 1 litre, 15 c.c. of the oil in question are heated to 110°. Then, whilst still continuing to heat, we pour upon the oil a mixture of 15 c.c. of a solution of soda at 40° Baumé in distilled water and of 15 c.c. of alcohol at 92 per cent. When the mass has become homogeneous we add, drop by drop, so as not to cool the paste and form clots, about ½ litre of distilled water. After boiling for a few minutes we separate the fatty acids by means of pure sulphuric acid diluted to one-tenth. As soon as the separation is complete and the sulphuric acid is in slight excess, 5 c.c. of the hydrated fatty acids are collected with a silver spoon and poured at once into a test-tube, about 3 c.m. in diameter and 12 in length. We add 20 c.c. of alcohol at 92° per cent, and heat slightly in the water-bath to dissolve the fatty acids. When the solution is effected, 2 c.c. of a solution of silver nitrate (30 grms. in 100 c.c. of distilled water) are added, the tube is placed in the water-bath and heated until about one-third of the mass is evaporated. The tube is then removed from the water-bath. Whatever is the origin of the olive-oil, its fatty acids remain unaltered if the oil is pure. But if cotton oil is present the silver is reduced, and blackens the fatty acids which rise to the surface. In this manner 1 per cent of cotton oil can be detected in olive oil.

Revue Universelle des Mines et de la Metallurgie. Series 3, Vol. i., No. 2, February, 1888.

This issue contains no original chemical matter.

Zeitschrift fur Analytische Chemie. Vol. xxvi., Part 5.

Contributions to the Methods of Examining Cod Liver Oil and Vegetable Oils.—Prof. E. Salkowski.—This bulky memoir is not capable of useful abstraction. The author's object is the detection of vegetable oils in animal fats, and especially in cod-liver oil.

Determination of Phosphoric Acid.—A. Isbert and A. Stutzer.—The authors wash the molybdic precipitate, not with ammonium nitrate or molybdate, but with cold water, and thus dissolve the ammonium phospho-molybdate. Five grms. of the substance under examination are heated in a half-litre flask with hydrochloric acid or aqua regia; when cold filled up at once to the mark with water, shaken up, filtered, 50 c.c. of the filtrate are mixed with an excess of ammonia, acidulated with nitric acid, and the phosphoric acid is precipitated with ammonium molybdate. The yellow precipitate, after it has completely settled (at 60° to 70°) is let cool and filtered at once, the supernatant liquid being first passed through the filter, the precipitate repeatedly washed by decantation, placed upon the filter, and repeatedly washed with water. The total volume of the washing water is about ¼ litre. The phosphoric acid is then volumetrically determined by the distillation method. Where an error of 0·1 per cent is the utmost limit the gravimetric method must be retained. The uranium titration process is not admissible.

Ultimate Analysis of Volatile Carbon Compounds.—Dr. G. Kassner.—This paper requires the accompanying figure.

On the Determination of Nitrogen by Kjeldahl's Process.—L. Lenz.—Where an accurate determination of nitrogen is required potassium permanganate should be used for oxidising the substance which has been boiled with suphuric acid.

The Sanitary Analysis of Air.—Klas Soudén.—The author's process cannot be made intelligible without the cut representing the apparatus.

Quantitative Determination of Antimony, founded upon the Ready Solubility of Hydrated Antimony Sulphide in Ammonium Polysulphide.—Dr. F. Muck.—The precipitate of sulphide, obtained in the ordinary manner and washed out, is dried until it begins to split off from the paper in curved fragments. These are removed from the filter as far as practicable by means of a

spatula and laid aside upon a glass plate. The funnel is placed over a capsule and the remainder of the precipitate is dissolved of from the filter by dropping upon it warm ammonium sulphide containing much free sulphur in solution. A very small quantity of this solvent suffices if the filtrate is poured back upon the filter. The filter is finally washed with ammonia, to which a little ammonium sulphide is added, the liquid is placed in a tared porcelain capsule, which is set under the exsiccator over sulphuric acid until most of the ammonia has escaped, and it is finally evaporated on the water-bath, adding the washings, and the main portion of the precipitate which had been set aside. The sulphide is converted into the so-called antimony antimoniate by Bunsen's process, and the sulphur is expelled as follows:—A few c.c. of carbon disulphide are poured into the crucible, stirred with a glass rod, chloroform is added, and the vessel is set for a few minutes upon a water-bath, slightly heated. The crucible is covered with a watch-glass, which is kept charged with cold water, constantly renewed. After allowing the mixture to settle for a few moments, the crucible is set in a flat-bottomed porcelain capsule, brought into a sloping position, and the liquid decanted. This digestion on the water-bath and decantation are repeated several times, rinsing the outside of the crucible each time with the solvent. The particles which have passed into the flat-bottomed capsule deposit and collect easily, and may be returned to the crucible, the contents of which are converted into antimony antimoniate and weighed.

Simple Apparatus for Evaporating Ammoniacal Liquids at Low Temperatures.—Dr. F. Muck.—The apparatus is essentially an exsiccator admitting of the application of heat, and thus serving instead of the air-pump.

Iodide Coatings before the Blowpipe. — Wheeler and Ludeking.—The author's results are given in the *Transactions of the St. Louis Academy of Science* (vol. iv., No. 4).

Indirect Determination of Alkalies, especially in Presence of Lithia.—K. Kraut.—The alkalies are converted into nitrates, weighed as such, and the proportion of nitric acid is determined by ignition with silica. Alkaline chlorides are converted into nitrates by precipitating the solution with silver nitrate, filtering, and removing silver by treatment with hydrocyanic acid (free from sulphuric acid). If phosphates are present they are dissolved in water, or in case of lithia in a minimum of nitric acid, a quantity of silver nitrate equivalent to the phosphoric acid is added, and the liquid is neutralised with moist silver oxide, freshly precipitated. When all the phosphoric acid is precipitated the excess of silver is removed by treatment with hydrocyanic acid. This method is not applicable if alkaline sulphates are present.

Detection of Nitric Acid in Well-waters. — Otto Binder.—The author adds to 30 c.c. of water a very small quantity of zinc powder and shakes well. He then adds a few drops of dilute sulphuric acid and shakes well. On adding iodised starch paste the reaction instantly appears.

Water Analysis.—Otto Binder.—In evaporating water it is necessary, in order to prevent the absorption of sulphur compounds, to place beneath the capsule a broad plate of iron or earthenware, or to evaporate in the water-bath.

Determination of Nitric Acid.—Dr. Kratschmer.—This process cannot be intelligibly summarised without the accompanying figure.

Analyses of Pure Alsace-Lorraine Wines, of the Season 1885.—Carl Amthor.—A paper of little interest.

Modifications in Gas lamps and Gas-cocks.—Hugo Schiff.—Unintelligible without the three accompanying figures.

Relative Permeability of Different Diaphragms for Dialysis.—A. Zott.—No particulars given.

Stand for Drying Precipitates in the Funnel.—V. Meurer.—This paper requires the accompanying illustration.

Tension of Mercury Vapour at Low Temperatures. —J. D. van der Plaats.—From the *Journal of the Chemical Society*.

Escape of Dissolved Solids during Evaporation of the Solvent.—P. Marguerite-Delacharlonny.—From the *Comptes Rendus*.

Determination of Ash by Means of Leidenfrost's Phenomenon.—Th. Salzer.—The author finds it practicable to incinerate organic matters which are either liquid in themselves or can be liquefied by heat in a faintly ignited platinum capsule.

Spectral Apparatus and Spectrum Analysis.—Brief mentions of a variety of appliances from the *Comptes Rendus*, the *Annalen*, and the *Chemiker Zeitung*.

Dispersion-polarimeter.—J. Seyffart.—This instrument consists essentially of a spectroscope giving the spectrum of a strong source of light. Light of a certain refrangibility is selected, and serves as the source of light for the polarising apparatus.

Variation in Weights (*Chemiker Zeitung*).—Decrease is due mainly to friction, and increase, especially in the finer weights, to internal oxidation or to the adhesion of dirt.

Specific Gravities of Salts and Saline Solutions.—G. Th. Gerlach.—The details are not given.

New Proposals for Determining Specific Gravities. —One of the methods proposed is the use of methylene iodide, which at 15° has a sp. gr. of 3·33.

Centrifugal Machine for Laboratory Purposes.—A. Watt.—From the CHEMICAL NEWS.

MEETINGS FOR THE WEEK.

MONDAY, 28th.—Royal Institution, 9. "Uber die Entstehung der Vitalen Bewegung—On the Origin of Vital Movement," by Professor W. Kühne. (In German).
—— Society of Chemical Industry, 8. "The Prospects of the Coal-gas Industry," by Mr. L. T. Wright.
TUESDAY, 29th.—Institution of Civil Engineers, 8. (Anniversary).
—— Royal Institution, 3. "Conventions and Conventionality in Art," by Sidney Colvin, M.A.
WEDNESDAY, 30th.—Society of Arts, 8.
THURSDAY, 31st.—Royal Institution, 3. "The Growth and Sculpture of the Alps," by Professor T. G. Bonney, D.Sc., LL D, F.R.S., &c.
—— Royal, 4.30.
—— Royal Society Club, 6.30.
—— Telegraph Engineers, 8.
FRIDAY, June 1st.—Royal Institution, 9. "Earthquakes, and How to Measure them," by Professor J. A. Ewing, F.R.S.
SATURDAY, 2nd.—Royal Institution, 3. "Count Tolstoi as Novelist and Thinker," by Professor C. E. Turner.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1488.

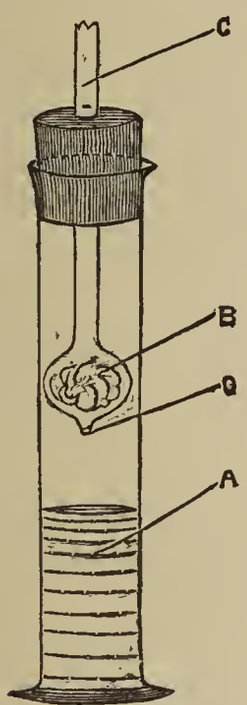
A SIMPLE FORM OF APPARATUS FOR GENERATING GASES BY THE ACTION OF LIQUIDS UPON SOLID SUBSTANCES.

By G. STILLINGFLEET JOHNSON.

The apparatus most in vogue at present for generating such gases as CO_2, H, and H_2S, is that of Kipp. The form of apparatus described below possesses certain advantages over Kipp's, notably on the score of economy.*

The construction of the apparatus will be best understood by reference to the accompanying diagram.

The bulb, B, is blown on a tube, C, and a small aperture is made at O. The solid substance is introduced into this bulb in small lumps (*e.g.*, marble, zinc, or ferrous sulphide) through the tube C. The hole in the cork should be large enough to allow the tube, C, to slide easily in it on the application of a slight degree of force. The liquid, by whose action the gas is to be produced, lies in the cylinder A. Now if the tube, C, be pushed down until the bulb is immersed in the liquid, the latter enters the bulb through O, and generates gas by acting upon the solid in B. The gas escapes through C, and may be led by a delivery tube, joined by rubber tubing to C, into any vessel designed to receive it.



Cylinder A.—Height, 6 inches; internal diameter, 1 inch.
Bulb B.—Diameter, $\frac{3}{4}$ inch.
Tube C.—Diameter, $\frac{1}{8}$ inch; length, 8 inches.

Many advantages which the apparatus possesses will be perceived on using it, but two may be pointed out here. The first is that, when a sufficient supply of gas has been obtained, the tube, C, may be raised till the bulb is out of the acid, when the action ceases.

The second is that the acid may be agitated at any time without disconnecting the delivery tube, thus avoiding cessation of action from spent acid adhering to the solid matter, which is one of the great disadvantages of Kipp's apparatus.

King's College, London,
May 23, 1888.

* F. E. Becker and Co., of Maiden Lane, Covent Garden, supplies the apparatus of the dimensions mentioned in the figure for the sum of 1s.

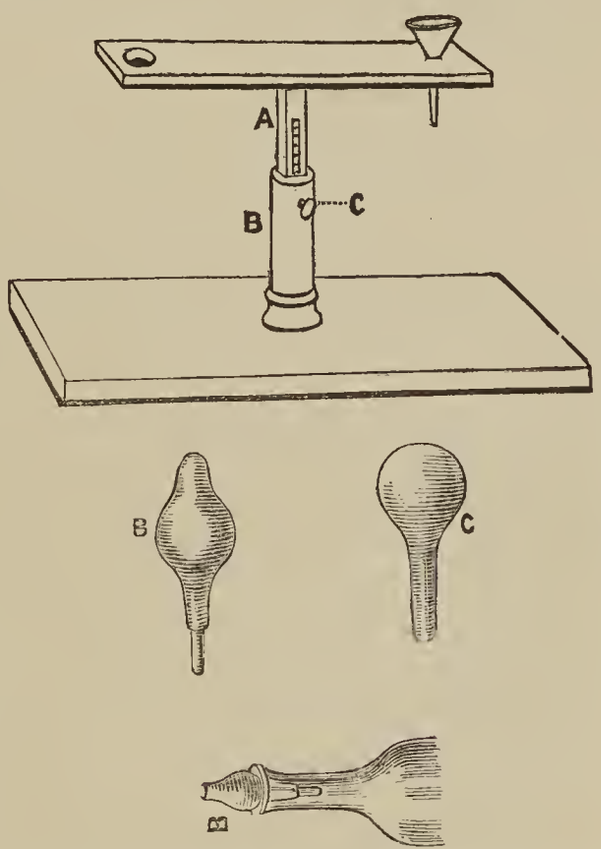
IMPROVED CHEMICAL APPARATUS.

By GEORGE H. BOSTOCK, F.C.S., &c.

I have devised an improved form of filter-stand, in which the inconvenience arising from the projecting end of the rod, on which the support for funnel slides, is done away with. In this form I make use of the rod and socket arrangement. A glance at the accompanying sketch fully illustrates my meaning without further explanation.

A is the rod having the funnel support affixed on its upper end; B is the hollow pillar into which A slides, being held firmly at any height by means of the screw at C.

Any ordinary joiner can make a filter-stand after this pattern.



Having often been annoyed by the frequency with which the valve made of india-rubber tubing—generally used when performing analyses by reduction, &c.—gets out of order and will not act, I was led to make use of a modification the nature of which is explained in a few words:—Instead of the piece of tubing with a slit in it I make a glass bulb, the size of which varies with that of the flask in use, and over this bulb I slip a small piece of india-rubber tubing sufficient to cover the bulb completely. The shank of the bulb should be about 3 c.m. long, and should be dropped into the neck of the flask so that the globular portion rests on the top. When ebullition has entirely ceased, and the flame is removed from under the flask, the partial vacuum caused by the rapidly cooled gases inside draws the bulb tightly down on the flask neck, thus making a perfectly air-tight stopper, which requires considerable force to remove.

A is the neck of the flask; B is the bulb with its covering of india-rubber; and C is the bulb without its covering.

The principal merit of the contrivance is its simplicity and certainty of action.

Widnes, May 14, 1888.

THE ACIDITY OF CARBONIC ACID.

A Lecture Experiment.

By THOMAS FARRINGTON, M.A., F.C.S., F.I.C.,
Analyst to the County Cork Agricultural Society.

It may not be generally known that the acidity of carbonic acid can be very easily demonstrated by passing a current of the anhydride through a solution of phenolphthalein made slightly alkaline with caustic soda.

The disappearance of the red colour takes place very quickly, and is far more conspicuous than the change from blue to purple in the case of litmus, especially when the experiment has to be performed by artificial light.

To show that the reaction is caused by the gas (and not by hydrochloric acid carried over mechanically), it is only necessary to boil the clear solution, when the red colour will be restored.

4, Waterloo Place, Cork,
May 22, 1888.

ESTIMATION OF TANNIN.

By CH. COLLIN and L. BENOIST.

The authors object to all the methods now in use, including those of Hanmer and Loewenthal, as the gelatinous matter employed retains, mechanically or in combination, a portion of the acids derived from the decomposition of tannin, such as gallic, ellagic, lactic, and butyric acids, a variety of salts, and saccharine matters. Hence they are untrustworthy, both from a scientific and a practical point of view.

The method employed by the authors depends, like some of the older processes, upon the precipitation of gelatin by tannin. They make use of certain standard solutions which must be prepared with great nicety :—

1. Normal solution of tannin : 5 grms. of tannin, absolutely pure and dried in the stove or in a vacuum, are dissolved in 1 litre of distilled water; but before making up the volume to 1 litre they add 0·5 c.c. of a solution of mercuric iodide (1 part in 10) dissolved in an equal weight of potassium iodide. The tannin solution is thus preserved from any alteration of strength arising from fermentation.
2. Standard solution of gelatin : dissolve with heat 5 grms. gelatin in a litre of distilled water ; heat to a boil, adding a sufficient quantity of egg-albumen to clarify it. When cold add 0·5 c.c. of the solution of mercuric iodide mentioned above, and render the liquid slightly alkaline by means of a solution of caustic soda.
3. Standard solution of calcium acetate : dissolve 50 grms. of pure dry calcium acetate in 1000 c.c. of distilled water ; filter, and then add a few drops of the mercuric iodide to prevent the formation of mould.
4. Solution of pure methylene blue, at 1 per cent.
5. Solution of Nicholson blue, at 4 per cent.
6. Solution of black blue " N.B.I.," at 1 per cent.

   The methylene blue is used in the determination of coloured tannins ; either of the two others for coloured tannins and extracts.
7. The burette with a glass cock used in the determinations must have a very tall graduation, so that 1-100th of a c.c. may be read off. The orifice must be drawn out to so fine a point that it may give at least 4 drops to 1-10th c.c. Such burettes have been made specially for the authors by the firm of Alvergniat.
8. A stoppered test-tube, 3 c.m. in diameter, and marked at 60 c.c.

To standardise the solution of gelatin we put into the test-tube 1 c.c. of the gelatin solution, adding 2 drops of methylene blue and 5 c.c. of the calcium acetate, and fill up to the mark with distilled water at 75° to 80°.

By means of the burette a little of the standard tannin solution is run in.

A precipitate is formed, the stopper is inserted, the mixture shaken up and let settle. The precipitate coagulates, and quickly rises to the surface.

We continue thus adding the tannin solution, little by little, shaking after each addition, until the decanted liquid is colourless. At this point all the gelatin is precipitated and the burette is read off.

Having thus determined, by means of the normal tannin solution, the volume required to decolourise the gelatin liquid employed, it is merely requisite, in analysing any tannin liquor, to use it in a second operation in place of the normal tannin. The proportion of the tannic liquors employed in these two operations gives their respective proportion of tannin.

If a solution to be titrated is very rich in tannin, it is well to dilute it previously with four or five times its volume of water. If very acid, they must be rendered but slightly acid by adding a few drops of a solution of caustic soda. The solutions of tannin, gelatin, and calcium acetate, sterilised as above with mercuric iodide, never lose their standard. No change has been discovered after the lapse of four months.

VOLUMETRIC DETERMINATION OF POTASSIUM AND SODIUM.

By JOHN TSAWOO WHITE.

Potassium may be separated from sodium as acid tartrate. A solution of pure acid ammonium tartrate, saturated at about 90° C., diluted with an equal volume of water, is the reagent. When used, the flask containing the reagent is heated till the crystallised tartrate is redissolved.

The salts are in the form of chlorides. Two solutions of potassium and sodium chlorides were prepared to do away with the frequent weighing out of the salts : 20 c.c. of the solution, containing about 0·2 grm., is measured into a 100 c.c. measuring flask ; 5 c.c. of ammonium tartrate for every 0·1 grm. added ; the solution is allowed to cool, and methylated alcohol is added in small portions, shaking after every addition till up to the mark. Filtered, after about three hours, into a burette, 10 c.c. is evaporated and ignited gently till the charred mass is white. Evaporate with a solution of ammonium chloride, ignite, and titrate the sodium chloride with a solution of silver nitrate, 1 c.c. = 0·001 Cl. Some of the results are given below. The sodium is found directly, and the potassium indirectly.

Taken.		Found.	
KCl.	NaCl.	KCl.	NaCl.
0·0769	—	0·0769	—
—	0·0925	0·0004	0 0921
0·0769	+ 0·0925	0·0731	0·0956
0·0769	+ 0·0925	0·0763	0 0930

I cannot account for the high result of NaCl of the third experiment, unless it was filtered too soon, an hour after precipitation. The precipitations were usually done in the evenings, and allowed to stand over-night. Three hours were, however, found sufficient from a trial of the mixed chlorides. The filtrate from the precipitate of the

solution of potassium chloride gave no fixed residue. In an early experiment, the adding of spirit at once in quantity lowered the quantity of sodium chloride by 0·0047.

I was led to these experiments by trying to found a method of separation based on the insolubility, discovered by Wurtz, of potassium alum in aluminium sulphate. The potassium of the alum might be determined by precipitating with barium chloride and then with ammonium carbonate, and titrating the potassium chloride formed, but the present process is simpler.

Rangoon College, April 26, 1888.

RESEARCHES ON ALLOISOMERISM.*

I.

By ARTHUR MICHAEL.

(Continued from p. 206).

II.—A Relation between the Constitution of Polybasic Unsaturated Organic Acids and the Formation of their Anilides.

By A. Michael and G. M. Palmer.

Behaviour of Maleic Acid towards Aniline.

It was shown in the preceding paper that an aqueous solution of aniline maleate, on boiling, gives maleic dianilide. A different result is obtained when a solution of acid aniline maleate in ten parts of water is allowed to stand in the cold. After standing a day a crystalline substance was deposited from the solution, which was filtered, and the operation repeated until no further deposit is formed. The crystals were purified by repeated crystallisation from alcohol, and are the acid anilide of maleic acid.

0·1746 grm. substance gave 0·4025 grm. CO_2 and 0·0875 grm. H_2O.

	Theory for $\begin{matrix}CH—CONHC_6H_5\\ \vert\\ CH—COOH\end{matrix}$.	Found.
C	62·82	62·91
H	4·71	5·56

The anilide crystallises from dilute alcoholic solutions in almost white prismatic plates, from concentrated solution in plates whose end-faces are imperfectly developed. The crystals melt at 207°. It is soluble in hot water and alcohol, moderately in cold alcohol. Dilute chlorhydric acid does not dissolve it, but it is soluble in dilute aqueous alkalies. Its formation is represented thus :—

$$\begin{matrix}CH—COONH_3C_6H_5\\ \vert\\ CH—COOH\end{matrix} = \begin{matrix}CH—CONHC_6H_5\\ \vert\\ CH—COOH\end{matrix} + 2H_2O.\dagger$$

Behaviour of Citraconic Acid towards Aniline.

An aqueous solution of mono-aniline citraconate behaves like the maleic acid compound, when it is allowed to stand in the cold. The solution deposits more or less rapidly, according to its dilution, large white crystals, which were crystallised from alcohol.

0·3175 grm. substance gave 0·7531 grm. CO_2 and 0·1532 grm. H_2O.

	Theory for $\begin{matrix}CH_3—C—CO—NHC_6H_5\\ \vert\\ CH—COOH\end{matrix}$.	Found.
C ..	64·39	64·67
H ..	5·36	5·37

The compound forms large white rhombic prisms which melt at 175°. It is insoluble in cold water and dilute chlorhydric acid, but dissolves in dilute alkalies to form salts, and acids precipitate the unchanged substance from such solutions. It is soluble in hot alcohol, moderately in cold.

The substance, obtained by Gottlieb* by treating citraconanil with ammonia and precipitating the solution with acetic acid, may be identical with our compound, but, as there are two isomeric acid anilides of citraconic acid possible, the identity must be left to be decided by a more detailed account of Gottlieb's compound, who mentions that a small yield was obtained by his method, while by the method just described almost the theoretical yield can be obtained. Gottlieb describes his compound as small glittering crystals. A solution of dianiline citraconate does not form an anilide on standing in the cold, but on boiling the anil separates. It melts at 98°.

Behaviour of Itaconic Acid towards Aniline.

Anschütz and Petri† and also Markownikoff‡ have observed that itaconic acid or its silver salt, when treated with acetyl chloride, gives an anhydride of the acid. This reaction cannot be considered as a proof that itaconic acid belongs to the maleic acid series, as the method used also causes the formation of anhydrides with acids that certainly do not belong to it, as succinic and pyrotartaric acids. The following experiments on the behaviour of itaconic acid towards aniline show quite conclusively, however, that it is to be classified as a member of the maleic series.

Five grms. of itaconic acid were dissolved in 50 grms. of water, and 3 grms. of aniline added. This solution was heated to boiling for half an hour, in a flask connected with a condenser, and on cooling gave a copious precipitate, which was purified by crystallisation from dilute alcohol.

0·3664 grm. substance gave 0·8657 grm. CO_2 and 0·1804 grm. H_2O.

	Theory for $\begin{matrix}CH_2—C—CO—NHC_6H_5\\ \vert\\ CH_2—COOH\end{matrix}$.	Found.
C ..	64·39	64·45
H ..	5·36	5·44

It crystallises in plates that melt at 189°, and is identical with the product obtained by Gottlieb§ by heating solid acid aniline itaconate. It is insoluble in dilute chlorhydric acid, but dissolves in dilute alkalies, and is precipitated unchanged from this solution by adding an acid.

The same compound is formed by allowing a solution of acid aniline itaconate in ten parts of water to stand for several days in the cold, when rhombic prisms that melt at 189° are deposited. It was impossible to obtain the anil of itaconic acid by heating an aqueous solution of its aniline salts.

(To be continued).

* *American Chemical Journal*, Vol. ix., No. 3.

† In view of the differences in the results obtained by Anschütz and Wirtz (*Annalen*, ccxxxix., 148), I repeated this experiment, unfortunately on a small scale, as I had but a few grms. of maleic acid at my disposal. The compound separates as crystalline plates that are soluble in dilute chlorhydric acid, but after several crystallisations from alcohol become insoluble in it, in fact they are insoluble in the strong acid. It is evident that the compound undergoes some change during crystallisation, and I am surprised that Anschütz and Wirtz did not take the trouble to crystallise their product before making note of supposed differences, as it is evident that reference was made in our preliminary note to the crystallised product. In regard to the melting-point, the specimen I examined decomposed partially before that temperature is reached, so that it is impossible to give a well-defined melting-point. The substance dissolves in dilute alkalies, but strong alkaline solutions set aniline free. An analysis of the product gave the following figures:—

0·2878 grm. substance dried in a vacuum gave 0·6087 grm. CO_2 and 0·150 grm. H_2O.

	Theory for $C_{10}H_{11}NO_4$.	Found.
C	57·41	57·68
H	5·26	5·76

The product analysed by Mr. Palmer was probably dried in vacuo at 100°, when it lost a molecule of water, although, as no mention is made in his notes of the conditions of drying, this must remain a surmise on my part. Whether the compound is the acid anilide with a molecule of water of crystallisation, can only be settled by a more detailed examination.—A.M.

* *Annalen der Chemie*, lxxvii., 280.

† *Berichte der Deutschen Chemischen Gesellschaft*, xiii., 1538.

‡ *Annalen der Chemie*, xiii., 1844.

§ *Annalen der Chemie*, lxxvii., 284.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 28th, 1888.

Address of the President, William Crookes, F.R.S.*

(Continued from p. 209).

Let us now return to our ultimate atoms, where the case, though much more complicated, is of the same character. We will suppose certain points in space where the first step in differentiation has been achieved. The ultimate particles have commenced to vibrate in their new born energy in all directions, and with velocities ranging from zero to infinity.† The law which we have traced from animated beings and coarse powders, down to the molecules of a rarefied gas, still holds good at this transcendental stage of matter, and the imagination can picture knots and voids gradually forming there as well as in Fleet Street. The slower particles will obstruct the quicker, the more rapid will rush up to the laggards in front, and we shall soon have groups forming in different parts of space. The constituents of each group whose rate of vibration is not in accord with the mean rate of the bulk of the components of that group will work to the outside and be thrown off to find other groups with which they are more in harmony. In time, therefore, a condition of stability is established between the various groups, and we may call these the molecules of our present system of elementary bodies.

With regard to the place where atoms come into existence, it seems to me almost certain that if their existence has had a beginning it has begun at the very edge of the protyle, or the confines of the ponderable Universe, and that their subsequent migrations have always been inwards.

In dynamical language, every new position into which an atom can glide must be from a position of higher to a position of lower potential. If the atom has had a beginning it must therefore have been where the potential is highest, *i.e.*, on the confines of the ponderable Universe, and if it comes to an end it must be where the potential is lowest, *i.e.*, in the centre of overgrown stars; so that the extinction of the central part of a star when it becomes overgrown is that which puts a limit to the size a star can attain by attracting to itself surrounding matter. This assigning of the places where chemical atoms have their origin and where they meet with extinction seems the only—or almost the only—conclusion we can yet with confidence advance.‡

From the above illustrations it will be seen that the constituent atoms of these molecules originally may not have been gifted with exactly the same speed or amplitude of vibration. In the molecule of a certain group let the form of energy which has for a factor what we call atomic weight be represented by the figure 35·5; it follows, from the foregoing exposition—which I have endeavoured to make clear—that whilst the great bulk of its component atoms have this atomic weight, a small percentage may vary from this figure to the extent of a decimal place, while a few others may stray as much as a whole number or two on one side or the other of the mean. The ultimate atoms whose rates are not exactly 35·5, but a little higher or lower than 35·5, will congregate around the 35·5 nucleus, forming a group whose average value will be 35·5. In like manner similar groups will be formed having the average rates of 80 and 127, whilst intermediate spaces will be cleared, the ultimate atoms which occupied these lone spaces being attracted to the chlorine, bromine, and iodine groupings. These groupings represent what at present we call elements, but which I conjecture may possibly consist each of an element and of a certain number of meta-elements, or each may be formed of a whole group of meta-elements, none of which greatly preponderates over the remainder.

On the threshold we encounter an objection very clearly stated by Clerk-Maxwell in his "Theory of Heat" (1871). "I do not think," says this eminent physicist, "that the perfect identity which we observe between different portions of the same kind of matter can be explained on the statistical principle of the stability of the averages of large numbers of quantities each of which may differ from the mean; for if of the molecules of some substance, such as hydrogen, some were of slightly greater mass than others, we have the means of producing a separation between molecules of different masses, and in this way we should be able to produce two kinds of hydrogen, one of which would be somewhat denser than the other. As this cannot be done, we must admit that the quality which we assert to exist between the molecules of hydrogen applies to each individual molecule, and not merely to the average of groups of millions of molecules."

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* From the *Journal of the Chemical Society* for May, 1888.

† Maxwell, "Atom," *Encyclopædia Britannica* (9th Ed.), iii., 40.

‡ For this fruitful suggestion and for other valuable criticism and advice on parts of this address I am indebted to my friend G. Johnstone Stoney, M.A., F.R.S.

Mr. G. Johnstone Stoney has given in the *Times* of April 4th, the following explanation of this passage:—

"There is nothing more certain in physical science than that, if atoms of ponderable matter are generated by any process of nature, they will inevitably thenceforth gravitate inwards towards the rest of the ponderable matter of the universe, and that, therefore, they must have come into existence at a position further out than those through which they subsequently pass. It may further be stated that some at least must have been formed at or beyond the limits now occupied by any ponderable matter. And it is also certain that their extinction, if it arrives at all, must overtake them in the position of lowest potential which they can reach, and that the position of lowest potential is at the centre of the largest star.

"You regard a limit to the universe as having been gratuitously invented for this theory. But have you not here overlooked what we are taught by the other sciences which, along with chemistry, bring us our knowledge of Nature? The lesson to which astronomy points is that the universe is limited. We know that the stars which constitute our Milky Way, our sun, and all the stars we see of a clear night form a detached group. It is certainly possible, and the facts that are known about the nebula in Andromeda make it probable, that there exist other groups of stars as numerous as we see in the Milky Way and scattered over our sky. The spectroscope indicates that that great nebula consists of stars, although their great distance precludes their being seen separately by any telescope, and their aggregate brightness is about the same as that of the Milky Way; in other words, they present very much the appearance which our great group of stars would have if seen from an equal distance. Moreover, a star outburst appeared among them, and has from time to time happened in our part of the universe. From these facts we may with probability infer that this nebula is a group of stars comparable to our great group. But that there are not an infinite number of such groups seems almost certain. It is a familiar theorem in optics that if stars in unlimited numbers sent us their radiations we should have 200,000 times as much light and heat as we actually receive, unless the radiations are absorbed or intercepted on the way to such an extent that only one two-hundred-thousandth part reaches us. This is so improbable that the alternative conclusion, that the universe is limited, is with some emphasis declared by astronomy. It was not, therefore, invented for the exigencies of the chemical hypothesis. Nor is a limited universe necessary for the statement made by Mr. Crookes. Whether limited or not, the ponderable universe consists of detached stellar groups, that of our Milky Way, that of the great nebula in Andromeda, and perhaps some others. The vast celestial spaces between these groups are beyond the confines of the universe in the sense required by Mr. Crookes's statement,—they are outside the universe of ponderable matter.

"Astronomy again comes to our aid with reference to the locality where atoms may become extinguished. Stars are not of all sizes. There is a distinct limit beyond which they cannot be ascertained to grow. The variety of their dimensions is like that found among the pebbles of a gravelled walk. There are none among them which, in comparison, are mountain masses or even boulders. There is, therefore, some cause in nature which puts this limit to their growth. And if chemical elements anywhere meet with extinction, this limitation of the size of stars is fully accounted for. On dynamical principles the extinction of an atom can only occur when it reaches its position of lowest potential, and the position of lowest potential is at the centre of the greatest star.

"It has always appeared to my mind a great recommendation of the hypothesis that there are processes in nature which convert radiant energy into the energy stored up in ponderable matter, that it relieves us from the vastly greater improbability of the only alternative hypothesis, viz, that the entire universe will become motionless and inert through the equable distribution or complete dissipation of its energy."

"The molecules of the same substance are all exactly alike, but different from those of other substances. There is not a regular gradation in the mass of molecules from that of hydrogen, which is the least of those known to us, to that of bismuth: but they all fall into a limited number of classes or species, the individuals of each species being exactly similar to each other, and no intermediate links are found to connect one species with another by a uniform gradation.

"In the case of molecules, however, each individual is permanent: there is no generation or destruction, and no variation, or rather no difference, between the individuals of each species."

"Our molecules are unalterable by any of the processes which go on in the present state of things, and every individual of each species is of exactly the same magnitude, as though they had all been cast in the same mould, like bullets, and not merely selected and grouped, according to their size, like small shot."

I think it evident that the statements here quoted, some of which involve no small amount of assumption, no longer accord with facts, for we actually do find variations between the properties of certain molecules which heretofore had been pronounced identical with each other. Take the case of yttrium. It had its definite atomic weight; it behaved in every respect as a simple body, an element, to which we might indeed add, but from which we cannot take way. Yet this yttrium, this supposed homogeneous whole, on being submitted to a certain method of fractionation, is resolved into portions not absolutely identical among themselves, and exhibiting a gradation of properties.

Or take the case of didymium: here was a body betraying all the recognised characters of an element. It had been separated with much difficulty from other bodies which approximated closely to it in their properties, and during this crucial process it had undergone very severe treatment and very close scrutiny. In short, until lately we might have said of it just what Clerk-Maxwell says of hydrogen, that the equality which we assert to exist between the molecules of didymium applies to each individual molecule, and not merely to the average of groups of millions of molecules. But then came another chemist who, treating this assumed homogeneous body by a peculiar process of fractionation, resolved it into the two bodies praseodymium and neodymium, between which certain distinctions are perceptible. Further, we even now have no certainty that neodymium and praseodymium are simple bodies. On the contrary, they likewise exhibit symptoms of splitting up.

Now if one supposed element on proper treatment is thus found to comprise dissimilar molecules, we are surely warranted in asking whether similar results might not be obtained in other elements, perhaps in all elements, if treated in the right way? We may even ask where the process of sorting-out is to stop? a process which of course presupposes variations between the individual molecules of each species.

And in these successive separations we naturally find bodies approaching more and more closely to each other. Dr. Auer von Welsbach, the discoverer of neodymium and praseodymium, remarks that these bodies "approximate more closely to each other than any two supposed simple bodies yet known." Thus we approach nearer and nearer either to a regular gradation in the molecules or to the recognition of those intermediate links, which I have named "meta-elements" or elementoids. A suggestion here occurs that it may be to the presence of these meta-elements that so many of the chemical elements, whilst approaching closely in their atomic weights the values required by Prout's law, deviate from it by a small but measurable amount. We can scarcely regard their approximation as purely accidental.

(To be continued).

Ordinary Meeting, May 17th, 1888.

Mr. WILLIAM CROOKES, F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs. John Alexander, M.A., 14, Caledonia Place, Perth; Charles Bradshaw, 174, Nottingham Street, Sheffield; Lewis Edmunds, 8, Grafton Street, Piccadilly, W.; William Humphrey Gibson, 107, King's Road, Brighton; Joseph Henry Maiden, Sydney, New South Wales; Henry Alexander Miers, M.A., Eden Cottage, Beckenham, Kent; Frank Mousley, Phillimore Terrace, Walham Green, S.W.; James Henry Rymer Paterson, 10, Millerfield Place, Edinburgh; George Woodyatt Procter, 18, Alice Street, Sunderland; Herbert W. Seeley, 11, Corn Market, Halifax.

The following were elected Fellows of the Society:—George Thomas Evans, John Campbell Fell, Albert Harrison, John Burchmere Harrison, M.A., Egbert Grant Hooper, John Hughes, Henry James Kirkman, William Parsons, Henry Charles Reynolds, Frank Goodell Wait.

The following papers were read:—

40. "*Researches on the Constitution of Azo- and Diazo-derivatives.* IV. *Diazo-amido-compounds.*" By Professor MELDOLA, F.R.S., and F. W. STREATFEILD.

Expressing the constitution of the mixed diazo-amido-compounds by the general formula $X{\cdot}N_3H{\cdot}Y$, the authors point out that in former papers they had given evidence that the alkyl derivative $X{\cdot}N_3R'{\cdot}Y$ was capable of existing in three isomeric modifications:—(1) from the action of $X{\cdot}N_2{\cdot}OH$ on $Y{\cdot}NH{\cdot}R'$; (2) from the action of $Y{\cdot}N_2{\cdot}OH$ on $X{\cdot}NHR'$; (3) from the direct alkylation of the compound produced by the action of $X{\cdot}N_2{\cdot}OH$ on $Y{\cdot}NH_2$, or of $Y{\cdot}N_2{\cdot}OH$ on $X{\cdot}NH_2$.

The only known case at present established is that of the ethyl derivatives of para-meta-dinitrodiazoamidobenzene, and the object of the present investigation has been to obtain other series of isomeric triplets. The triplet of methyl-derivatives is first described. By the direct methylation of the mixed para-meta-compound a derivative of m. p. 148° is obtained. By the action of diazo-*p*-nitrobenzene chloride on methyl-*m*-nitraniline a derivative is obtained melting at 168°. The third isomeride, formed by the action of diazotised *m*-nitraniline on methyl-*p*-nitraniline, melts at 176—177°. The triplet is thus shown to confirm the isomerism indicated by the ethyl-derivatives. Methyl-derivatives of *p*-dinitrodiazoamidobenzene (m. p. 219°) and the corresponding *m*-compound (m. p. 127—128°) have also been prepared. A considerable number of other new diazoamido-compounds have been obtained in the course of a search for triplets of alkyl-derivatives, of which two members at least are required as solids. It has been found that mixed diazoamido-compounds cannot be obtained from the nitranilines and *p*-chloraniline, as the resulting product is always a mixture of the two symmetrical compounds. A very small quantity only of the mixed compound—

$$(p)NO_2{\cdot}C_6H_4{\cdot}N_3H{\cdot}C_6H_4Cl(p)$$

is formed under certain conditions by the action of diazotised *p*-nitraniline on *p*-chloraniline. In conclusion, the authors give a series of numerical results obtained by the analytical method described by them in a former paper, and which show that the amount of azonaphthol compound, $X{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH\beta + Y{\cdot}N_2{\cdot}C_{10}H_6{\cdot}OH\beta$, produced by the decomposition of the diazoamido-compounds by hydrochloric acid represents the quantitative resolution:—

$$2X{\cdot}N_3H{\cdot}Y + 2HCl = X{\cdot}N_2{\cdot}Cl + \\ + X{\cdot}NH_2 + Y{\cdot}N_2{\cdot}Cl + Y{\cdot}NH_2.$$

41. "*The Colour of some Carbon Compounds.*" By THOMAS CARNELLEY, D.Sc., and JOHN ALEXANDER, M.A., University College, Dundee.

A careful investigation of a number of metallic derivatives of ortho- and para-nitrophenol has given the fol-

lowing results:—(1) In all cases without exception the colour passes towards the red end of the spectrum as the temperature rises. Organic compounds thus behave like inorganic substances. (2) The colour of the ortho-derivative is nearer the red end than that of the corresponding para-compound. Para-compounds almost always melt higher than either of the corresponding ortho- or meta-compounds, and the probability is that of two isomeric bodies which are of different colour the one with the lower melting-point will have a colour near the red end of the chromatic scale than the one with the higher melting-point. This is only what we should *a priori* expect, for the compound with the lower melting-point is at a correspondingly higher temperature than the other, and according to (1) the higher the temperature the more does the colour pass towards the red end. (3) A comparison of the nitrophenates of metals belonging to the same sub-group shows that the colour passes towards the red end as the atomic weight of the metal increases. This accords with the results observed by one of the authors (*Phil. Mag.*, 1884 [5], xviii., 130) in the case of inorganic salts. (4) When the same salt occurs in both the anhydrous and hydrated state, the colour passes towards the red end as the quantity of water of crystallisation diminishes. The exceptional behaviour in this respect of such inorganic salts as copper sulphate is possibly due to the breaking down of the crystals on dehydration, which of itself frequently makes a coloured body become white or nearly so. (5) As regards the salts investigated, the para-compound always takes up a larger quantity of water of crystallisation than the corresponding ortho-compound.

Discussion.

Dr. ARMSTRONG remarked that the facts advanced were far too few to justify the very general conclusions arrived at by the authors; all who had worked with the nitrophenols were well aware that the colour changed on heating in the manner described; and there was no novelty in the statement that the paranitrophenates crystallised with the larger proportion of water. Referring to the suggested explanation of the colourlessness of dehydrated copper sulphate, he quoted calcium parachlorodiorthonitrophenate as one of the exceptions to which such an explanation did not apply: this compound could be obtained either in yellow anhydrous crystals, or in deep orange hydrated crystals.

Mr. FRISWELL mentioned magnesium and barium platinocyanide as instances of loss of colour taking place without loss of crystalline form; the hydrated magnesium compound was of a splendid red colour, but when gently heated it became lemon-yellow, and when anhydrous it was white; if care were taken, the dehydration could be effected without the slightest apparent injury to the crystals.

Professor THORPE said that he and Professor Judd had recently had occasion to examine the cyanides referred to, and he thought that in reality the dehydrated crystals were mere pseudomorphs.

Mr. WARINGTON mentioned having succeeded in expelling the ammonium sulphate from ammonium magnesium sulphate without changing the form of the crystals.

42. "*The Identity of Natural and Artificial Salicylic Acid.*" By W. N. HARTLEY, F.R.S.

In order to determine whether natural and artificial salicylic acid are the same substances, specimens prepared by Kolbe's process and from oil of winter-green were carefully recrystallised and examined by means of the spectrum. They were found to give identical series of photographs, and hence the same curve.

43. "*Researches on the Relation between the Molecular Structure of Carbon Compounds and their Absorption-spectra.* (Part VIII.)" By W. N. HARTLEY, F.R.S.

Isomeric Cresols, Dihydroxybenzenes and Hydroxybenzoic Acids.—The ultra-violet spectra of these substances were carefully examined, with the object of ascertaining how far they are alike or different from each other.

The *oscillation frequencies* of the extreme rays transmitted by 1 m.grm.-molecule of the four series of substances, including xylenes previously examined, are the following:—

	Xylenes.	Cresols.	Dihydroxy-benzenes.	Hydroxy-benzoic acids.
Ortho	3611	3433	3466	3359
Meta	3580	3413	3399	3080
Para	3537	3359	3151	2986

It appears from this table that the law which determines the order of greatest absorption is not the same in the series of isomeric hydrocarbons as in the series of cresols and dihydroxybenzenes. In the hydroxybenzoic acids it is the reverse of that in the xylenes.

The curves of molecular vibrations afford evidence of the relative extent to which energy is dissipated during the formation of the molecules of the substances, and they are classified according to the indications of the curves.

44. "*A Definition of the Term Atomic Weight and its Reference to the Periodic Law.*" By W. N. HARTLEY, F.R.S.

The atomic weights are too frequently viewed by those who become familiar with them in the capacity of teachers or as students, either as proportional weights, as combining weights, or as mere numbers with which calculations can be made for analytical or other purposes. That they are real measures of the *quantity of matter* in the atoms of the elements is often overlooked. The reason of this is due to the ambiguous use of the word *weight*. A weight is a measure of the attraction between the earth and the matter weighed, or, as it is more familiarly stated, a measure of the *earth's attraction* for the body weighed. The common method of determining relative quantities of matter is by weighing, and though the determination of the weight of a body does not actually determine its mass, yet the weight of a substance is proportional to its mass.

A so-called atomic weight is therefore a numerical proportion. There are 70 elements and 70 atomic weights, and these represent 70 different quantities of matter in 70 different atoms; or in other words, they represent matter in 70 different states of condensation.

I am of opinion that the teaching of chemistry is very much facilitated by the use of the following definition, which I have used for some years past, and I would recommend its general adoption:—*The atomic weight of an element is the ratio of the mass of its atom to the mass of an atom of hydrogen.*

The term atomic weight should be abolished and atomic mass substituted. Similarly, molecular weight should be defined as the *mass of a molecule* or *molecular mass*. The statement that the molecular weight of a compound is the sum of the weights of the atoms of the elements contained in it becomes simplified thus:—*The mass of a molecule is the sum of the mass of its constituent parts.*

Whatever remarks are applicable to the inconveniences arising from the term atomic weight, they may be emphasised in dealing with the Periodic Law. If we accept it as correctly stated, thus:—The properties of the elements are a periodic function of their atomic weights; then the ambiguous use of the word weight, and the tendency to see in the atomic weights only a series of numbers, obscures the true meaning of the law. A quotation from a recently published paper of great interest affords evidence that an important corollary of the law has been overlooked. Thus, Professor Roberts-Austen refers to the fact that Carnelley has given strong evidence in favour of supplementing the law as follows:—"The properties of *compounds* of the elements are a periodic function of the atomic weights of their constituent elements." (*Proc. Roy. Soc.*, xliii., 425, 1888). This was recognised by Mendeleeff, for he headed the columns in his table of the

atomic weights with their most characteristic oxygen and hydrogen compounds, such as—

$$M_2O,\ MO,\ M_2O_3,\ \frac{H_4M}{MO_2},\ \frac{H_3M}{M_2O_5},\ \&c.$$

Furthermore he predicted the properties of the various hydrates, oxides, and salts of scandium with most remarkable accuracy when he described those of eka-boron. Inasmuch as the properties of compound substances depend almost entirely upon their composition, and that both the chemical and physical properties of the elements are a periodic function of their so-called atomic weights, it follows that the periodical relationship must influence the compounds into which the atoms enter. During the last six years I have made a practice of stating the periodic law in a much more concise and, at the same time, comprehensive manner, thus:—*The properties of the atoms are a periodic function of their masses.*

Thus the chemical and physical properties of both elements and compounds are directly connected with the quantity of matter entering into them.

In any graphic representation of the periodic law the fact that it is upon the mass of the atoms that their properties depend should appear prominently. The diagram of Dr. G. Johnstone Stoney, F.R.S., used to illustrate his paper on the "Logarithmic Law of Chemistry," recently read before the Royal Society, has on this account alone a pre-eminent importance.

The elements are distributed on a logarithmic curve of the second order, their masses being represented by volumes which are proportional to radii by which the curve is described, and which are derived from numbers which are the cube roots of the atomic weights. Its most essential feature is a representation of the ratios of the masses of the atoms of other elements to the mass of the atom of hydrogen, and the consequent variation in chemical and physical properties accords with the positions of the elements upon the diagram.

At the next meeting on June 7th there will be a ballot for the election of Fellows, and the following papers will be read:—

"The Chemical Action of some Micro-organisms." By R. Warington, F.R.S.

"The Optical and Chemical Properties of Caoutchouc." By J. H. Gladstone, F.R.S., and W. Hibbert.

NOTICES OF BOOKS.

Handbook of Modern Chemistry, Inorganic and Organic. For the Use of Students. By Charles Meymott Tidy, M.B., F.C.S., Professor of Chemistry and of Medical Jurisprudence and Public Health, at the London Hospital. (Second Edition, revised and enlarged). London: Smith, Elder, and Co.

This work occupies an intermediate position between the comprehensive treatises of Gmelin, Watts, Miller, or Roscoe and Schorlemmer, and, on the other hand, the slighter handbooks, manuals, and vade-mecums which are now quite sufficiently plentiful. Dr. Tidy writes more especially for the use of medical students,—a praiseworthy undertaking if we consider that not a few practitioners of standing are not too well versed in chemical science, and are sometimes even accused of combining in one prescription substances which respectively decompose each other.

The views expressed by the author in his Preface and in the "Epistle Dedicatory" seem to us practical and judicious. He omits the constitutional formulæ which he has used in his lectures, remarking that "On the whole it seems preferable, in view of the many-sided relationships of different chemical compounds, to avoid their systematic representation of any single scheme of constitutional formulæ, necessarily representing them in a single aspect only."

In nomenclature the writer is less of a precisian than many of his contemporaries. If he is understood he feels, not unjustifiably, satisfied. He remarks:—"I confess that the growing necessity for having a translation at one's side in attempting to understand the modern scientific paper is, in my opinion, a circumstance to be deplored. Danger, moreover, is always to be apprehended when a language has to be invented to support a theory or a formula. A party shibboleth has no doubt a charm for its special clique. It serves as a bond of union for the uninitiated, whilst it prevents the interference of outsiders. But, all the same, it is distracting to the general worker, and can but prove a hindrance to the general cultivation of Science."

Carrying out these views we find Dr. Tidy, instead of the alien terms "perissads" and "artiads," using the plain English words "odds" and "evens," which are shorter, quite as precise, and are certain to be "understanded of the people." It would be well if biologists, both British and American, would follow this wholesome example.

The general principles of the chief chemical manufacturers are here given, as such knowledge is in many districts absolutely essential for medical officers of health. The descriptions of the plant and processes are of necessity somewhat brief, but a fuller account would scarcely have been practicable within the compass of the work.

As regards the periodic law it may be questioned whether sufficient prominence has been given to Mr. Newlands's share in this capital discovery.

The recent results obtained by Thomsen and Berthelot in thermo-chemistry are very clearly summarised.

As a whole the work seems to us admirably well adapted for the use of medical students.

The International Scientists' Directory: containing the Names, Addresses, Special Departments of Study, &c., of Amateur and Professional Naturalists, Chemists, Physicists, Astronomers, &c. Compiled by S. E. Cassino. Boston: S. E. Cassino.

We have here an exceedingly useful work, the compilation of which must have involved enormous difficulties. We find certainly the names of some well-known scientific men wanting, but if they have neglected to fill up and return the forms sent them the editor cannot be fairly blamed.

In looking over the names here catalogued we are struck with the very extensive list of specialities to which some persons lay claim,—some of them, moreover, not very closely connected. Thus one gentleman cultivates botany, geology, mineralogy, crystallography, lithology, metallurgy, electricity, bibliography, taxidermy, and entomology; another is devoted to botany, horticulture, geology, mineralogy, chemistry, metallurgy, physics, electricity, photography, anatomy, and entomology; a third studies ornithology, oology, geology, crystallography, palæontography, land and fresh-water shells, war (!), historical and mound-builders' relics, numismatics, and philatry—whatever the last word may mean. We can only hope that these three gentlemen, and a few others who might be named, have made their arrangements to live to the age of Prof. Chevreul, whose name, by the way, does not figure in this Directory.

The Compounds of Cuprous Chloride, Bromide, and Iodide with Aniline.—André Saglier. — Cuprous chloride, bromide, and iodide, if heated in excess with aniline in sealed tubes, form a series of compounds perfectly crystalline, and corresponding to the formulæ of the cupro-ammonium salts.—*Comptes Rendus*, cvi., No. 20

CORRESPONDENCE.

ON SOLUTION.

To the Editor of the Chemical News.

Sir,—Dr. Durham accuses me of having made two errors in stating the signs of certain quantities in my criticism of his paper on this subject. He is quite right, and I apologise. But he is somewhat too hasty (to use a mild expression) in attempting to dismiss the criticism by stating that "the other instances given are of a precisely similar nature, and need no further comment," for a more careful examination of my statements would have shown him that these two errors exactly counterbalanced each other (being, in fact, mere errors of transcription), and did not affect in the least my final results. He had only to take his original equation (stated correctly) and substitute determined for the undetermined quantities contained in it (correcting the error that I had made in one of these), and he would have got the same results as I did. Thus: Dr. Durham states, as a discovery fraught with theoretical importance, that—

$$Ca,Cl_2 - Ca,O,Aq - Mg,Cl_2 + Mg,O,Aq = = MgCl_2,Aq - CaCl_2,Aq.$$

The first four terms cannot be determined directly, but are calculated in the following manner:—

$$Ca,O,Aq = R + H_2,O$$
$$Ca,Cl_2 = 2(H,Cl,Aq) + R + N - CaCl_2,Aq$$

R being the heat evolved when the metal is dissolved in water, and N the heat of neutralisation of the resulting solution with hydrochloric acid. With magnesium compounds we have a different value for R, say R', but the same value for N. Hence Dr. Durham's equation becomes:—

$$[2(H,Cl,Aq) + R + N - CaCl_2,Aq] - [R + H_2,O] - [2(H,Cl,Aq) + R' + N - MgCl_2,Aq] + [R' + H_2,O] = = MgCl_2,Aq - CaCl_2,Aq$$

Cancelling those terms which occur twice with opposite signs, this simplifies (as I stated) into—

$$MgCl_2,Aq - CaCl_2,Aq = MgCl_2,Aq - CaCl_2,Aq$$
or 18,510 cal. = 18,510 cal.

an obvious truism, by which science will not be much benefitted.

If Dr. Durham knew, as he implies he did, that the quantities on one side of his equation were dependent on those of the other side, it was inexcusable in him to give (as he did in one case) one side as =985 cal., and the other as =990 cal., implying that this concordance of "found" and "calculated" values proved the justness of his theory, when both the values are the "found" values for the *same* quantities, and must necessarily be identical.

As to my views on residual affinity, I certainly might have claimed originality, but as Dr. Durham will find on reference to my first communication on the subject "Atomic Valency," and Pamphlet, *Chem. Soc. Proc.*, 1885, 122, I was very careful in not claiming any priority in the enunciation of such views.

In conclusion, I must thank Dr. Durham for his kind wishes as to the prolongation of my life for another seven years, but I very much doubt whether such a period will be long enough to convert me to his methods of interpreting thermo-chemical data.—I am, &c.,

Spencer Pickering.

Harpenden, May 15, 1888.

Reaction of Thymol.—R. Stormer.—If thymol is dissolved with the aid of heat in moderately strong potassa lye and a few drops of chloroform are added, there appears at once a violet colour.—*Zeit. Anal. Chem.*, xxvi., Part 5.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 20, May 14, 1888.

Fluorescence of Cupriferous Lime. — Lecoq de Boisbaudran. — Calcium carbonate containing a little copper oxide gives, after ignition in contact with air, a substance which shows in a vacuum an extremely brilliant light green fluorescence. No spectral rays were distinguished.

Action of Hydrochloric Acid upon the Solubility of Stannous Chloride. — M. Engel.— It is generally admitted that the solubility of stannous chloride in water increases in presence of hydrochloric acid. This is true only when the quantity of acid added to the saturated solution of the chloride exceeds a certain proportion. It is possible to obtain a definite hydrochlorate of stannous chloride.

The Existence of a Pyrophosphorous Acid. — L. Amat. — The author obtains sodium pyrophosphite by heating sodium monophosphite to 160°. The salt loses 6 mols. of water, and is converted into the pyrophosphite.

The Composition of the Hydrates of Sulphuretted Hydrogen and of Methyl Chloride.—MM. de Forcrand and Villard.—The authors conclude from their experiments that the formula of hydrated methyl chloride is $C_2H_3Cl + 18HO$, whilst that of hydrogen sulphide is $HS+7HO$.

Essay on the Equivalents of the Simple Bodies.—M. Delauney.—This paper will be inserted in full.

Researches on the Synthesis of the Albumenoid and Proteic Matters.— P. Schützenberger.—Any proteic matter treated in heat with a solution of barium hydroxide takes up the elements of water and is split up into various products belonging to one of three categories. (1) Products of the scission of urea and oxamide by hydration: ammonia and the carbonic and oxalic acids. (2) leucines; and (3) leuceines.

On Cinchonibine.— E. Jungfleisch and E. Leger. — This compound, $C_{38},H_{22}N_2O_2$, is an isomer of cinchonine. It forms small colourless rhomboidal prisms, strongly refractive. It melts at 259°, and if heated suddenly it sublimes with little change of colour. It is insoluble in water, ether, and weak alcohol, but dissolves in strong alcohol with the aid of heat. It is biacid, and its basic salts turn litmus slightly blue.

Syntheses by Means of Cyanacetic Ether. — Alb. Haller and L. Barthe.—The authors have obtained two new compounds, the cyano-succinic and cyano-tricarballylic ethers.

Preparation of Methyl-benzoyl-cyanacetate and of Cyanacetophenone,—L. Barthe.—The author has prepared methyl-benzoyl-cyanacetate by treating sodium methyl-cyanacetate by benzoyl chloride.

The Oil of Eucalyptus Globulus.—R. Voiry.—The author has obtained eucalyptol in a state of purity. It is a colourless mobile liquid, of the sp. gr. 0·940; its formula is $C_{20}H_{18}O_2$; it melts at +1° and crystallises at 0°.

The Combination of the Anhydrides of Mannite with Oil of Bitter Almonds.—J. Meunier.—The author has obtained with benzoyl a compound in which 3 mols. of benzoic aldehyd replace three of the mols. of water of the original mannite.

Presence of Maleic Acid in the Sweat of Herbivora.—A. and P. Buisine.—The authors have detected malic acid in the "suint" waters obtained in abundance in the industrial washing of raw wool.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 5.

Filter-cutting Apparatus. — Göttig. — The author (*Chemiker Zeitung*) proposes hollow steel cylinders sharpened at one end, like cork-borers.

Apparatus for Continual Washing. — P. Raikow (*Chem. Central-Blatt*).—An apparatus in which the level of the water is regulated by a float. It flows down upon the precipitate in the funnel through a syphon until the level is the same in both vessels.

A Refrigerator.—H. Michaelis (*Chemiker Zeitung*).—A Liebig's condenser with its cooling tube bent at right angles, and passing through an oblique perforation of the stopper of the upright distillatory vessel.

Continuously-acting Suction-apparatus. — F. Molnár (*Repertorium der Analyt. Chemie*).—This paper requires the accompanying figure.

Improved Analytical Apparatus.—R. Bensemann.—These appliances, including an absolvent receiver for distillations and an extraction-apparatus, cannot be described without the accompanying figures. Full accounts may be found in the *Repertorium fur Analyt. Chemie.*

Apparatus for Determining Hydrogen Peroxide in Commercial Samples.—Maurice de Thierry.—From the *Comptes Rendus.*

Improvements in Burettes.—C. Meissner.

Ether Pipette for the Areometric Determination of Fat in Milk.—F. Soxhlet.

Continuous Gas-generator. — Chr. Steenbuch. — These three papers cannot be reproduced without the accompanying figures.

Use of Phosphoric Anhydride for Drying Gases.—J. Walter.—From the *Journal fur Prakt. Chemie.*

Absorbents for Vapour of Carbon Disulphide.—A. Eiloart.—From the Chemical News.

Substitutes for Sulphuretted Hydrogen and Ammonium Sulphide in Chemical Analysis.—H. Hager.—The author proposes potassium or ammonium sulphocarbonate and ammonium sulphocarbaminate.

Lead Chromate in Elementary Analysis.—Ljubavin.—Lead chromate often evolves, on ignition, carbonic acid, and may occasion errors in organic analysis. "Th. P.," writing in the *Chemiker Zeitung*, recommends that the chromate should be fused in a copper crucible.

Potassium Tetra-oxalate for Standardising Permanganate Solutions.—R. Ullbricht recommends this salt, which was proposed by K. Kraut thirty years ago, and has since been regularly used in his laboratory.

Volumetric Determination of Barium, Strontium, and Calcium.— O. Knöfler.—The author adds to the solution in question a mixture of phenolphthalein and methyl-orange (1 grm. of each in 250 c.c. alcohol). Hydrochloric acid is added to incipient acidity (reddening of the methyl-orange), and heated to boiling, which is continued if necessary until any carbonic acid present is expelled. A one-fifth normal solution of sodium carbonate is then run in; the alkaline reaction which appears at first disappears at once in case of barium and strontium, aad after a few seconds in calcium salts. As soon as a faint rose colour remains, 1 c.c. of the soda solution is added and the deep red liquid is filtered through a wet folded filter and washed once with water. The filtrate is immediately titrated back with one-fifth normal sulphuric acid, until the final reaction with methyl-orange appears. The volume of the soda solution, after deducting the number of c.c. of acid corresponding to the quantity of the alkaline earth present. Ammonium salts must not be present. Magnesium salts cannot be titrated in this manner.

Separation of Iron Oxide and Alumina.—Vignon.—The author adds to the dilute solution an excess of trimethylamine and filters after twenty-four hours. All the ferric oxide remains on the filter, whilst the alumina passes into solution. Chromium oxide may be separated from iron in the same manner.

Separation of Uranium from Alkaline Earths and Alkalies.—A. Remelé.—The author recommends ammonium sulphide as the best reagent for this purpose, except in case of barium. Recently Foullon and also Alibegoff find that uranium and calcium cannot be separated in this manner. Foullon recommends in this case the use of ammonium oxalate in a solution previously rendered alkaline by ammonium carbonate. He first mixes the hydrochloric solution with a little ammonium oxalate, and then adds ammonium carbonate until all the uranium oxide is re-dissolved; ammonium oxalate is then added in excess, and let deposit in the absence of strong light. Alibegoff, working in this manner, obtained better results than with ammonium sulphide, but the calcium oxalate was always more or less contaminated with uranium. He therefore adds to a solution of uranium chloride some elutriated mercury oxide, when the uranium is completely deposited on boiling, and the supernatant liquid has quite lost the colour of the uranium salts. In case of uranium solutions in the oxygen acids, a solution of ammonium or sodium chloride is added. A very dilute solution of ammonium chloride is used for washing; as the precipitate, a mixture of uranyl hydroxide and basic mercury uranate, is slightly soluble in water. In carrying out this method the author adds to the solution of uran-oxychloride a few drops of an ammonium chloride solution, and heats to a boil. He then adds the pure elutriated mercuric oxide, carefully avoiding excess. After again boiling and shaking round (in preference to stirring) let cool, when the precipitate settles quickly, and the liquid becomes colourless. Decant a few times, bring upon the filter, and wash in cold water containing ammonium chloride. The precipitate along with the filter is heated in a platinum crucible, carefully at first, then in the uncovered crucible with a gradually increasing heat, and lastly over a blast. The product is weighed as the olive-green uranious uranic oxide. In presence of uranium and calcium the process is the same. If the alkaline earths are in very large proportion, their partial precipitation may be avoided by boiling up once more after decantation with water containing ammonium chloride. In the filtrate the strontium and calcium are determined in the usual manner after removing the mercury with ammonium sulphide. Uranium may be separated from magnesium by boiling with a sufficiency of ammonium chloride and then precipitating with mercuric oxide as above.

Opening up Tin Ore.—W. Hampe (*Chemiker Zeitung*).—The author weighs the mineral, very finely ground in a porcelain boat, which he places upon a platinum foil in a tube of very infusible glass. He passes pure dry hydrogen gas through the tube, and heats to redness for one to two hours. The water formed during the reduction can be collected and weighed by known methods. When cold the contents of the boat are treated at a gentle heat with dilute hydrochloric acid, and any undissolved residue is filtered off and again submitted to the same operation. The tin is thrown down from the hydrochloric solution by sulphuretted hydrogen, and the precipitate and filtrate are treated in the ordinary manner. By this process insoluble silicates, aluminates, &c., are separated from the tin-stone and admit of a separate examination.

Delicate Detection of Arsenic. — O. Schlickum (*Pharm. Zeitung*).—If a minute crystal of sodium sulphite (0·001 to 0·002 grm.) is placed in a solution of 0·3 to 0·4 grm. stannous chloride in pure hydrochloric acid (sp. gr. 1·124) there is liberated not merely sulphurous acid but hydrogen sulphide, the latter owing to the reductive action of the stannous chloride upon the sulphurous acid. If some arseniferous hydrochloric acid is cautiously poured over it, there appears, if only 1-20th m.grm. of arsenious acid is present, a yellow ring of arsenic sulphide at the line of junction of the two liquids. This ring gradually increases up-

wards, and if ½ m.grm. is present it colours the entire upper stratum of acid yellow in the course of a few minutes. With arsenic acid the reaction requires a few minutes, but it may be obtained even with 1-20th m.grm. arsenic acid if the test-tube is placed in warm water. This process succeeds in presence of bismuth and antimony, as the sulphides of these metals do not form in a strong hydrochloric solution. The only conditions are the use of strong hydrochloric acid and of a minimum of sodium sulphite.

On Arsenic Pentasulphide.—Leroy W. McCay.—From the Chemical News.

Determination of Phosphoric Acid.—C. Meinecke.—The author proposes an abridgment of the molybdic method. If the ordinary yellow precipitate is heated to 400° to 500°, water and ammonia are expelled, and there remains a molybdenum phospho-molybdate almost of a black colour. This compound, within certain limits of temperature, is very permanent, and as it is not hygroscopic it can be weighed. The author proceeds as follows:—The solution of the phosphate, prepared as usual, and containing nitric acid and from 20 to 25 per cent ammonium nitrate, is precipitated at 50° to 60° with solution of molybdic acid, stirring constantly, and is allowed to stand for some hours without further heating, but with diligent stirring. After two to three hours the precipitate is collected on a filter, washed with a 20 per cent solution of ammonium nitrate slightly acidulated with nitric acid, until ten drops react neither with hydrogen sulphide nor (if iron is present) with potassium ferricyanide, and then a few times with cold water, or once each with a small quantity of cold water, alcohol, and ether. The dried precipitate is removed as completely as possible from the filter into a flat platinum capsule. The filter is incinerated separately at the lowest possible temperature in a platinum crucible, the ash is added to the bulk of the precipitate in the flat capsule, which is then covered with sheet platinum and ignited over a "Maste" burner with a triple air current at a temperature which suffices for a slow decomposition of the precipitate, indicated by blackening. If there is a considerable quantity of precipitate it is removed, after a time, from the flame, crushed with a glass rod having its end melted broad and flat, and heated again, bringing the yellow portions, which still remain unchanged, nearest the sides of the capsule which are hottest. In about fifteen minutes the mass is generally of a uniform blackness. It is let cool in the exsiccator and weighed. It contains 4·018 per cent P_2O_5. The residue can easily be removed from the capsule by means of dilute ammonia. If the temperature has been too high, and the residue has a light grey reflection, indicating partial formation of molybdic acid, the operation is not to be rejected. The mass should be carefully moistened with dilute ammonia, dried up, and heated afresh, but with caution in order to avoid loss by spirting.

Determination of Fluorine in Commercial Phosphates.—A. Chapman.—From the Chemical News.

Volumetric Determination of Nitrous Acid.—A. G. Green and F. Evershed (*Journal of Society of Chem. Industry*) have developed a method proposed by A. G. Green and S. Rideal in the Chemical News.

Reagent for the Hydroxyl Group.—H. A. Landwehr.—The author proposes ferric chloride as a reagent, which gives characteristic colours with the phenoles and ortho-oxy-acids. The reaction occurs only if the hydroxyl is intact, and does not take place if the hydroxyl-hydrogen has been substituted by acid or alcohol radicles. Ferric chloride gives also a coloured reaction with bodies of the fatty series containing the hydroxyl group, but the ferric chloride must be very much diluted.

A Coloured Reaction of the Ortho-diketones.—E. Bamberger.—The author dissolves a trace of the substance in question in alcohol and adds to the hot solution a drop of caustic lye, avoiding access of air. There appears a dark red colour, almost black in case of very strong solutions, which disappears on shaking with air.

Coloured Reactions for Determining the Constitution of Carbon Acids of the Pyridin, Chinolin, and Analogous Series.—H. Skraup.—No details are given.

Detection of Pyrogallic Acid.—G. Kliebahn.—The author converts pyrogallic acid into rufigallic acid by fusion with ammonium oxalate. The mass obtained dissolves in water with a red colour and gives the following reactions:—Potassium ferricyanide and potassium dichromate give a dark brown precipitate. Ferric chloride produces no blackening. Potassium cyanide and mercurous nitrate give a black precipitate if the solution has been acidulated with acetic acid.

Detection of Salicylic Acid.—O. Curtman.—If phenol is present the author mixes the sample in a test-tube with 1 c.c. methylic alcohol and adds carefully ½ c.c. strong sulphuric acid. He then heats to a boil, sets it aside, and boils again. The odour of the salicylic methyl-ether (Gualtheria oil) is then distinctly recognised.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Chemical Manufacturers of America.—We should be obliged if any correspondent could give us the name and the publisher's address of a good Directory of the chemical manufacturers, brokers, and drysalters of the United States of America.—T. H. A.

MEETINGS FOR THE WEEK.

Monday, 4th.—Royal Institution, 5. General Monthly Meeting.
—— Society of Chemical Industry, 8. "Modes of Using Char," by Messrs. B. E. and J. R. Newlands. "Olive Oil and its Adulterations," by Mr. T. T. P. Bruce Warren.
Tuesday, 5th.—Royal Institution, 3. "Conventions and Conventionality in Art," by Sidney Colvin, M.A.
Wednesday, 6th.—Geological, 8.
Thursday, 7th.—Royal Institution, 3. "The Growth and Sculpture of the Alps," by Professor T. G. Bonney, D.Sc., LL.D., F.R.S., &c.
—— Chemical, 8. Ballot for the Election of Fellows. "The Chemical Action of some Micro-organisms," by R. Warington, F.R.S. "The Optical and Chemical Properties of Caoutchouc," by J. H. Gladstone, F.R.S., and W. Hibbert.
Friday, 8th.—Astronomical, 8.
—— Quekett Club, 8.
—— Royal Institution, 9. "Phosphorescence and Ozone," by Professor Dewar, M.A., F.R.S.
Saturday, 9th.—Royal Institution, 3. "Count Tolstoi as Novelist and Thinker," by Professor C. E. Turner.
—— Physical, 3. "On the Analogy between Gases and Substances in Dilute Solution," by Prof. J. H. van 't Hoff, communicated by Prof. W. Ramsay. Exhibition of a Lantern, by Mr. W. Lant Carpenter.

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THE CHEMICAL NEWS.

VOL. LVII. No. 1489.

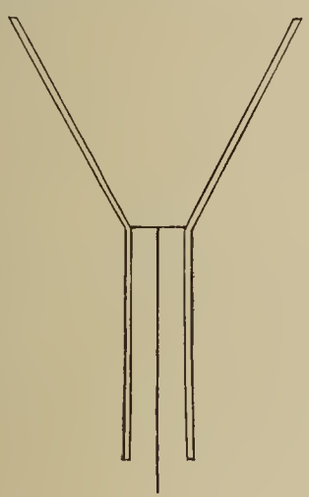
NOTE ON A FUNNEL FOR FILTERING CARBON.

By THOMAS M. DROWN, M.D

THE essential feature of the unnel, as illustrated in the accompanying sketch, is the cylindrical stem; the external diameter of which should be a trifle smaller than the internal diameter of the porcelain tube into which the carbon is ultimately transferred for combustion. This stem, in the funnels used in the analytical laboratory of the Institute, has a diameter of half an inch, the porcelain tubes being five-eighths of an inch diameter internally.

To support the asbestos which retains the carbon, a flat coil of rather heavy platinum wire is used, one end of which extends from the centre of the coil to a little below the end of the stem, as shown in section in the drawing.

The asbestos, which should be well broken up, but still fibrous, is, while suspended in water, poured on to the coil, when the funnel is connected with the suction-pump. It is desirable to have the funnel at least one-fourth full of asbestos. If a suction-pump is not available, a loose mass of asbestos fibre may be used, which fills the funnel about one-half or two-thirds full.



When the carbon is all on the filter and completely washed, the particles adhering to the sides of the funnel are removed by rubbing with a little moist asbestos held in forceps, and this asbestos is put on top of the carbon.

The coil of wire is now taken out of the funnel by pulling on the vertical wire in the stem, and the funnel is set aside to dry.

When ready for combustion, the stem of the funnel is inserted into one end of a porcelain tube, which contains near its other end a layer of copper oxide, retained in place by plugs of asbestos. The transference of the asbestos and carbon to the tube is very simply and completely effected by means of a glass rod. Any particles of carbon adhering to the glass are easily removed by gentle friction with asbestos. The mass of asbestos and carbon are thrust well into the middle of the tube, and the sides of the tube are freed from any particles of carbon by pushing down several light plugs of asbestos.

The advantages of this form of funnel are, first, that the cylindrical stem permits the asbestos to be immediately transferred to the tube without loss; and, second, that the wide upper portion of the funnel allows the liquid containing the carbon to be poured rapidly and freely.

Platinum tubes and boats are often used for filtering off carbon, and the great advantage in their use consists in the fact that they can be directly inserted into the porcelain tube without removal of their contents. But this advantage is accompanied by the drawback that they present but little surface for filtering, and the liquid containing the carbon must, consequently, be poured on to the asbestos very slowly, and with great caution. Where a large number of funnels are required, the expense of the platinum is also worth considering.

A copper-wire coil may be used in cases where it would not be dissolved. In filtering the acid solution of cupric chloride in the determination of total carbon in iron, I have used a moderately heavy copper wire, which, although somewhat attacked, retains sufficient strength to support the asbestos to the end of the operation.

A variation in the usual method of carbon determinations in iron and steel has been successfully tried with this funnel. The iron borings have been placed directly on the asbestos filter, and the solution of the cupric-ammonium chloride has been passed over it by means of a syphon, delivering about a drop a second.

From 100 c.c. to 150 c.c. of a nearly saturated solution of the double chloride is sufficient to dissolve all the iron, so that the residue on the filter, which contains some metallic copper, may be washed with dilute hydrochloric acid. It is washed finally with water, dried, transferred to the combustion tube, and burned in oxygen without regard to the presence of any metallic copper which may be present.

The direct decomposition of iron by the double chloride in a glass tube in which the combustion is subsequently made, would seem to be a still more perfect method of determination of carbon, since it involves no transfer at all. But the advantage in the use of a porcelain tube for the combustion is so great, on account of its being unaffected by the sudden application of heat, and by the highest temperature of the combustion furnace, that it is worth while to take a little more time to transfer the carbon—time which is fully compensated for in the greater ease and security in conducting the combustion.—*Technology Quarterly*, May, 1888.

THE SOLUBLE ACTION OF ROCHELLE SALT ON THE METALLIC HYDRATES.

By H. N. WARREN, Research Analyst.

THE general solvent action that a tartrate such as Rochelle salt possesses towards the metallic hydrates and carbonates is—for instance, in the case of the ferric and cupric compounds—too well known to need further description. But on a comparison being made with the other compounds of a similar class, or group, a marked assimilation is observed. Not only does the solvent action of Rochelle salt predominate over the ferric and like compounds, but also to an equal extent over the ferrous, dissolving them with great facility, forming a deep green solution; and it is also exercised to a similar extent over the hydrated precipitates of zinc, manganese, nickel, cobalt, iron, chromium, and aluminium; even the precipitates of compounds of barium, strontium, calcium, and magnesium are to a considerable extent soluble when boiled with a concentrated solution of the Rochelle salt.

Owing to the ready manner in which antimony oxychloride is dissolved by this salt, I have several times observed lecturers, when demonstrating or instructing beginners, advise the use of this compound as a reagent for determining whether the precipitate formed is one of antimony or bismuth, or whether both are in admixture: this is, however, entirely erroneous, and is apt to lead a beginner widely astray, since both compounds are entirely dissolved on adding a sufficient quantity and heating.

The same compound is not uncommonly used when a quick method is required to distinguish between a precipitate supposed to be either one of antimony or tin; notwithstanding the entire list of stannic compounds are almost as readily soluble in a solution of this reagent as are the antimonic precipitates.

An exception to this rule appears to exist in the case of cadmium carbonate, which is practically insoluble in a neutral tartrate solution, such as is afforded by a solution of Rochelle salt. Cadmium salts, when in solution, may by suitable means by this compound be therefore separated from those of the cupric, those of the latter being, as are well known, soluble in excess of that salt.

I have not as yet fully experimented with respect to the solvent action of Rochelle salt on the rarer earths,—zirconia, glucina, &c.,—but am of opinion that it may possibly open an easy means of separating such oxides when in the hydrated condition.

Everton Research Laboratory,
18, Albion Street, Everton, Liverpool.

RESEARCHES ON ALLOISOMERISM.*

I.

By ARTHUR MICHAEL.

(Concluded from p. 215).

Behaviour of Citraconic Acid towards some other Aromatic Primary Amines.

It seemed to be of interest to ascertain whether other primary aromatic amines than aniline would show similar reactions with citraconic acid, and to what degree the basic property of the amine could be decreased without its losing the power of giving the anilide reaction.

A solution of acid paratoluidine citraconate in five parts of water gives, on warming, a crystalline precipitate that melts at 161°, and when crystallised from absolute alcohol melted at 166°. This compound is probably the acid toluide. When it is crystallised several times from boiling water it is converted into a different substance, which is the tolil.

0·3670 grm. substance gave 0·9625 grm. CO_2 and 0·1885 grm. H_2O.

0·3631 grm. substance gave 0·9552 grm. CO_2 and 0·1815 grm. H_2O.

	Theory for $CH_3-C(-CO)-CH(-CO)>NC_6H_4-CH_3$.	Found.	
C	71·64	71·50	71·71
H	5·46	5·69	5·56

Citracontolil crystallises from water in long silky needles that melt at 114·5°. It is insoluble in dilute chlorhydric acid and alkalies, soluble in alcohol and hot water, sparingly soluble in cold water.

Mono-ortho-toluidine citraconate dissolves readily in cold water. This solution becomes turbid on boiling, and if the heating is continued for about half an hour an oil separates. On cooling, a further quantity of oil was deposited, that on standing gradually became solid. It was insoluble in dilute chlorhydric acid, and was evidently a toluidide.

α-Naphthylamine citraconate in aqueous solution gives an oily precipitate on boiling, which solidifies on standing. The compound crystallises from alcohol as yellow plates that melt at 141° and may be sublimed unchanged. The compound is insoluble in dilute chlorhydric acid and alkalies, and probably represents citracon-naphthylimide.

A solution of β-naphthylamine citraconate also deposits a substance on boiling. This compound, crystallised from water, forms yellow feathery needles that melt at 170° and may be sublimed without change. It is insoluble in dilute chlorhydric acid.

The behaviour of metamido-benzoic acid towards citraconic acid is of particular interest, as this substance is so weak a base that it does not form salts with monobasic organic acids. A solution of one part of citraconic acid in five of water dissolves metamido-benzoic acid (equivalent proportions) very slowly in the cold, rapidly on warming. When this solution is boiled a crystalline precipitate is soon deposited, which was purified by crystallisation from hot water.

0·3802 grm. substance gave 0·8710 grm. CO_2 and 0·1366 grm. H_2O.

	Theory for $CH_3-C(-CO)-CH(-CO)>N-C_6H_4.COOH$.	Found.
C	62·33	62·46
H	3·89	4·00

Meta-citraconanil-carboxylic acid crystallises from water as fine prismatic needles that melt at 218°. It is soluble in hot alcohol and water, sparingly soluble in cold water, and insoluble in dilute chlorhydric acid. Dilute solutions of alkalies dissolve it to form salts.

Although it did not seem likely that citraconic acid would form an anilide with sulphanilic acid, as this amido compound does not even form salts with mineral acids, an experiment was made that gave negative results. Corresponding to the anilides, derivatives of phenylhydrazine have been obtained by using analogous methods. Our expectation that phenylhydrazine would form an azide on heating with aqueous citraconic acid was fulfilled. A solution of monophenylhydrazine citraconate in ten parts of water, when boiled, turns yellow, and a crystalline precipitate soon separates, which is considerably increased as the solution cools. It was purified by crystallisation from alcohol.

0·3903 grm. substance gave 0·9441 grm. CO_2 and 0·1851 grm. H_2O.

	Theory for $CH_3-C(-CO)-CH(-CO)>N_2HC_6H_5$.	Found.
C	65·34	65·89
H	4·95	5·24

It crystallises in long bright yellow prismatic needles that melt at 160°, and are sparingly soluble in cold, pretty soluble in hot water, and readily in hot alcohol. It is insoluble in dilute chlorhydric acid. As citraconic acid does not form anilides with secondary amines, the reaction is very likely correctly expressed by the following equation:—

$$CH_3-C(-COON_2H_4C_6H_5)-CH(-COOH) = CH_3-C(-CO)-CH(-CO)>N-NH-C_6H_5 + 2H_2O.$$

Behaviour of Phthalic Acids towards Aniline.

The phthalic acids are distinguished by the capability of the ortho acid of forming an anhydride. All attempts to obtain a similar derivative of the other two acids have been futile. As the ease that polybasic acids form anhydrides evidently is in close relationship with the anilide reaction, and ortho-phthalic acid forms its anhydride with readiness, it seemed of interest to examine whether this reaction would not serve to distinguish between these isomeric acids.

The acid aniline phthalate is difficultly soluble in cold, but dissolves readily in hot water. If a solution of this salt in six parts of water is boiled in a flask connected with a cooler, it will be noticed that a precipitate gradually separates from the hot solution, that increases as the solution cools. The acid aniline salt is readily decomposed by dilute chlorhydric acid, forming the chlorhydrate and free acid, while the precipitate formed by boiling a solution of the salt is insoluble in that acid.

* *American Chemical Journal*, Vol. ix. No. 3.

It melts at 203°, and agrees in all its properties with phthalanil. The anil is also formed by boiling an aqueous solution of the neutral aniline salt, and when a solution of the acid salt is allowed to stand at ordinary temperature for some days.

Isophthalic acid also forms an acid aniline salt, but its solution in water may be boiled for hours without anything separating from it, and on cooling yields unchanged salt that is readily soluble in dilute chlorhydric acid. An aqueous solution of the neutral aniline salt gave the same result.

Terephthalic acid unites with aniline, but with difficulty, and the salt is unstable in presence of considerable water. A solution in a small quantity of hot water was boiled for an hour without any change taking place, and a like result was obtained by heating an aqueous solution of the neutral salt.*

Behaviour of some Saturated Polybasic Acids towards Aniline.

It seemed desirable to show that the property of forming anilides on heating an aqueous solution of aniline salts is characteristic of a certain group of unsaturated acids, and not shown by polybasic saturated fatty acids. We shall make but a brief mention of our experiments in this direction, and include in it several experiments with unsaturated acids. Acid aniline oxalate is difficultly soluble in hot water. After boiling its aqueous solution for a long time, long flat prisms separate on cooling. They are soluble in dilute chlorhydric acid, and consist of unchanged salt.

Acid aniline malonate dissolves readily in cold water. Its solution undergoes no change on boiling.

Acid aniline succinate is difficultly soluble in cold water, but dissolves in hot. It undergoes no change when its aqueous solution is boiled.

One part of tartaric acid in ten parts of water will dissolve sufficient aniline to form the acid salt. On boiling this solution a precipitate separates. This, however, represents an aniline tartrate, as it is immediately decomposed by dilute chlorhydric acid.

Acid aniline citrate is soluble in cold water, and does not change when its aqueous solution is boiled.

Acid aniline camphorate dissolves in boiling water, and after cooling separates unchanged as an oil that gradually solidifies.

Acid aniline pyrotartrate (obtained by reducing citraconic acid) is soluble in hot water, and undergoes no change when its aqueous solution is boiled.

Acid and neutral aniline mucates do not form anilides when their aqueous solutions are boiled.

Summary.

I. Unsaturated polybasic organic acids may be divided into two classes according as their aniline salts, in aqueous solution, split off water to form anilides or remain unchanged. The anilide-forming acids are classified as belonging to the maleic acid series, and the others to the fumaric acid series.

II. Of the acids as yet examined the following belong to the maleic series: maleic, brommaleic (m. pt. 128°), dibrommaleic acid (123°), citraconic, itaconic, bromcitraconic, aconitic, and orthophthalic acids. To the fumaric series: fumaric, bromfumaric (178°), chlorfumaric (191°), mesaconic, mucic, camphoric, and iso- and terephthalic acids.

III. Chlor- and bromfumaric acids, in aqueous solution, when boiled with aniline are converted into the anil of phenyl-amidomaleic acid.

IV. The bromine atoms of dibrommaleic acid are symmetrically grouped.

V. The acids of the maleic series give the anilide reaction with all primary salt-forming aromatic amines, but not with secondary or tertiary aromatic bases. On this property a method of separating these bases has been based.

VI. The acetates of primary amido-benzenes are not decomposed by cold water, while those of the secondary or tertiary amines, if formed at all, are decomposed. A separation of basic mixtures has been based on these properties.

VII. Saturated polybasic acids do not give the anilide reaction.*

VIII. The results obtained in this investigation cannot be brought in harmony with the hypothesis that acids of the maleic series contain a divalent carbon.

IX. The anhydride and anilide formation of orthophthalic and similar acids probably depends on their belonging to the maleic series, and not on the positions of the carboxyls as represented by the constitutional formulæ now in use.

X. Aqueous solutions of the citraconates of fatty amines do not form alkylamides.

* There is no doubt but that a very convenient method or detecting the presence of carboxyls in ortho position in aromatic acids can be based on their forming anilides from aqueous solutions of their aniline salts. The existence of a second orthophthalic acid that would stand in the same relation to orthophthalic acid that fumaric does to maleic acid also seems probable

* This rule is certainly not without exceptions, as experiments with the aniline salts of the dibenzyldicarboxylic acids have shown, which will be published later. The behaviour of aniline salts of polybasic organic acids in their aqueous solution will be continued, and I wish to reserve the further examination of the reaction until my research is completed.

PROFESSOR SCHORLEMMER, LL.D., F.R.S.

A COMPLIMENTARY Dinner was given on May 25th at the Queen's Hotel, Manchester, to Prof. Schorlemmer, of the Owens College, by his former pupils, to inaugurate the occasion of the conferring of the degree of LL.D. upon him by the Senate of the Glasgow University and to offer their congratulations.

In the absence of Sir Henry E. Roscoe, M.P., who had been expected to be present and to act as chairman, one of Prof. Schorlemmer's eldest pupils or friends, Mr. R. S. Dale, took the chair.

Amongst those who accepted the invitation were S. R. Platt, Esq., J.P., of Oldham; A. M'Dougall, Esq.; W. J. Hurst, Esq.; Prof. T. E. Thorpe, Ph.D., F.R.S., of the Normal School of Science, South Kensington; Prof. Dreschfeld; Prof. A. Smithells, of the Yorkshire College, Leeds; Prof. W. C. Williams, of Firth College, Sheffield; Francis Jones, Esq., F.R.S.E., of the Manchester Grammar School; Prof. P. P. Bedson, of the Newcastle College of Physical Science; Dr. C. A. Kohn, of University College, Liverpool; Dr. J. B. Cohen, of the Owens College; Messrs. Hermann Woolley, H. Baker, H. Grimshaw, W. H. Darling, L. T. O'Shea, Hindle, and J. Hulme. Dr. G. H. Bailey and Mr. Watson Smith, of the Owens College, together with the Chairman, formed the committee of management, and in response to their invitation the following friends of Prof. Schorlemmer were present:—Prof. Dixon, F.R.S., of the Owens College; Dr. Edward Schunck, F.R.S.; Dr. Gerland; Ivan Levinstein, Esq.; Dr. J. Grossmann; L. Siebold, Esq.; R. F. Gwyther; J. B. Millar, Esq., and others.

Numerous congratulatory letters and telegrams were received by Dr. Schorlemmer, both from this country and from the Continent, and early in the evening a letter was read from Sir Henry Roscoe, M.P., regretting that he would not be present, and testifying to the high appreciation and regard he felt for the ability and talents of his old friend and colleague, as well as for his personal qualities. Sir Henry claimed that just as Sir Humphry Davy discovered Faraday, so he, with the aid of Prof. Dittmar, discovered Schorlemmer, in that home of so many great German chemists, Darmstadt. Telegrams of congratulatory import were then read from Dr. Pauli, director of the firm of Meister, Lucius, and Brüning, in Hoechst;

and from Prof. Bernthsen, of the Badische Anilin und Sodafabrik, in Ludwigshafen; and, finally, a very warm and highly eulogistic letter from Prof. Hermann Kopp, of Heidelberg, the great historian of chemistry, bearing testimony to the eminent position Schorlemmer has attained as one of the principal pioneers of the science of organic chemistry and one of its first exponents, both as a teacher and a writer.

Prof. THORPE proposed the health, long life, and prosperity of Dr. Schorlemmer, and referred to the fact that Glasgow, which had thus conferred honour on Prof. Schorlemmer, had given rise to men such as Black and Thomson, names familiar to all chemists.

Prof. DIXON expressed the hope that he might have the pleasure and advantage of working for many years yet to come with such a colleague as Prof. Schorlemmer, and adding the regret that he had not enjoyed the privilege shared by so many around him of having been one of his pupils.

It may be interesting to note that it is principally to Schorlemmer's researches in the laboratory of the old Owens College in Quay Street that the science of chemistry owes the present system and orderly arrangement of the formerly obscure but very extensive and important branch of the paraffins and their alcoholic and acid derivatives. His researches into the constituents of American petroleum and the demonstration of the true constitution of those components, the paraffins, form classic ground. The isolation of the pure colouring-matter aurin and the preparation of a series of its derivatives, with the final triumph in the shape of the transformation of aurin into pararosaniline, a research carried out in conjunction with his friend and the chairman of the evening, R. S. Dale, are achievements forming a chapter in organic chemistry of which the chemical department of the Owens College may be justly proud. These and many other researches Schorlemmer in bygone years has shared with his pupils, and we are quite sure that a reunion such as took place on this occasion was not only a source of pleasure to their honoured guest himself, but served to recall agreeable memories of a connection with Owens College extending now over thirty years.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Anniversary Meeting, March 28th, 1888.

ADDRESS OF THE PRESIDENT, WILLIAM CROOKES, F.R.S.*

(Concluded from p. 217).

WE now come to the last objection pertinently set forth by Clerk-Maxwell to the hypothesis that the elements are not absolutely homogeneous. He writes:—"It is difficult to conceive of selection and elimination of intermediate varieties, for where can these eliminated molecules have gone to if, as we have reason to believe, the hydrogen, &c., of the fixed stars is composed of molecules identical in all respects with our own?"

In the first place we may call in question this absolute molecular identity, since we have hitherto had no means for coming to a conclusion save the means furnished by the spectroscope, whilst it is admitted that for accurately comparing and discriminating the spectra of two bodies they should be examined under identical states of temperature, pressure, and all other physical conditions. We have certainly seen, in the spectrum of the sun, rays which we have not been able to identify.

We have supposed the cosmic cycle re-entering in successive periods, during a fall of temperature, the same region—say, for instance, where chlorine, bromine, or iodine have been formed. If most of the atoms present approximate more or less closely to 35·5, 80, or 127—the atomic weights of these three bodies—they will be in consequence easily disposed of. But there may be besides a few intermediate atoms having, say atomic weights of between 36 and 79 and between 81 and 126. These atoms will be attracted to the masses on one side or the other of the cyclical track. We can even imagine sparse atoms scattered so far from the centre line of track as to be midway between chlorine and bromine or between bromine and iodine; these wanderers likewise will be slowly picked up and will gravitate to chlorine, bromine, or iodine; and, being thus accounted for, none need be eliminated.

It is not impossible, moreover, that the elementary atoms themselves are not the same now as when first generated. For if an atom has commenced its existence at a certain epoch, and may go through such vicissitudes that it will cease to exist, it seems at least probable that it may undergo inward change. These vicissitudes probably directly affect only the primary motions which constitute the existence of the atom, but they indirectly, and only in a slight degree, affect those secondary motions which produce all the effects we can observe—chemical effects, heat effects, electrical, and so on. Thus, while the life of an atom may be waning away under the various experiences to which it is subjected, it may, and probably does, appear to us the same as at first. But perhaps not quite, so that atoms originally alike, taken from different minerals collected at widely separated stations on the earth, *may* have had sufficiently different past histories to have come to be markedly different in regard to the primary motions which elude our observation, and through the very slight influence which changes in the primary motions have on the secondary motions, *may* be just perceptibly different under our experiments. From this point of view a rare element, like a rare plant or animal, is one which has failed to develop in harmony with its surroundings.

This view lends itself very naturally to the facts we encounter in our fractionation experiments. Where all the ultimate atoms have precisely identical rates of vibration, any fractionation is impossible. Where such rates are not identical the process proves successful; and all the more easily the wider the differences among the vibration-rates of the ultimate atoms. The bodies thus split off necessarily very closely approximate to each other, and the further we push our fractionations the less marked are the differences.

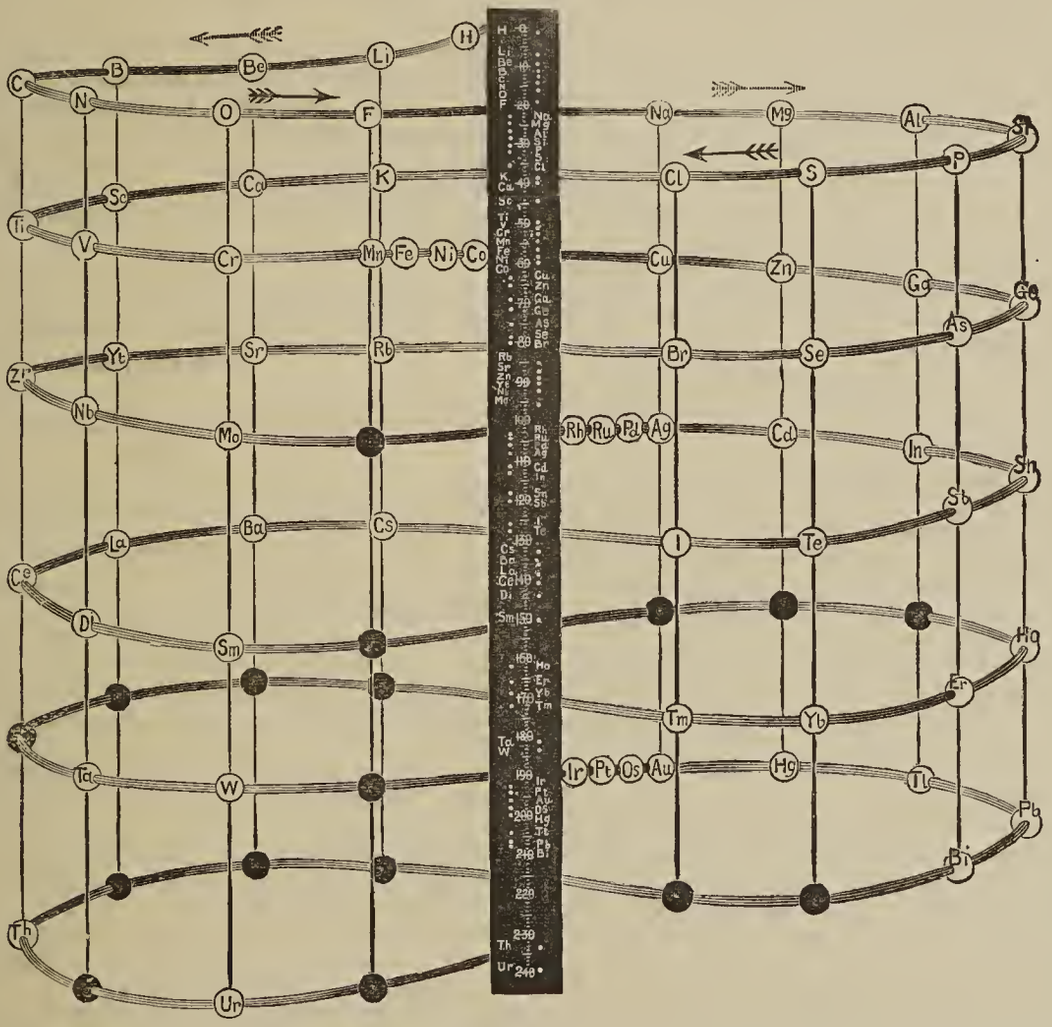
But as we review the series of elements arranged on the curve I adopted from Professor Emerson Reynolds to illustrate my address on the "Genesis of the Elements," delivered before the Chemical Section of the British Association (Birmingham Meeting), we cannot fail to be struck by a consideration which at first sight appears absolutely fatal to the notion of the production of the elements from a series of "knots," as just described. If the element which we call aluminium has been formed from ultimate atoms having rates of vibration of the rate 27, or a little more or less, so as to give a mean of 27, and if the atoms between aluminium and the next element in the series have in this manner been sorted out to the one hand or the other, leaving a void between, we should expect that their properties would not differ very widely from each other, or at least that they would present considerable analogies. Now to a certain extent this is actually the case. Upon aluminium follows silicon. We may perhaps conceive these two elements as springing from the differentiation of a nearly homogeneous swarm of ultimate atoms. But if we pursue the curve onwards, what elements follow? Phosphorus, sulphur, and chlorine, bodies heterologous with each other and heterologous with silicon. We can scarcely imagine original atoms, so to speak, in doubt which of two aggregations they should join

* From the *Journal of the Chemical Society* for May, 1888.

the one being silicon and the other phosphorus. Nor can we conceive of anything being split off from sulphur which should make even the slightest approximation to chlorine.

It appears to me, however, that these difficulties are more apparent than real. In the Birmingham Address already referred to, I asked my audience to picture the action of two forces on the original protyle, one being *time*, accompanied by a lowering of temperature; the other, swinging to and fro like a mighty pendulum, having periodic cycles of ebb and swell, rest and activity, being intimately connected with the imponderable matter, essence, or source of energy we call *electricity*. Now a simile like this effects its object if it fixes in the mind the particular fact it is intended to emphasize, but it must not be expected necessarily to run parallel with all the facts. Besides the ebb and flow of temperature with the periodic ebb and flow of electricity, positive or negative, requisite to confer on the newly born elements their particular atomicity, it is evident that a third factor must be taken

FIG. 2.



nto account. Nature does not act on a flat plane; she demands space for her cosmogenic operations, and if we introduce *space* as the third factor all appears clear.

Instead of a pendulum, which though to a certain extent a good illustration is impossible as a fact, let us seek some more satisfactory way of representing what I conceive may have taken place. Let us suppose the zigzag diagram not drawn upon a plane, but projected in space of three dimensions. What figure can we best select to meet all the conditions involved?

Many of the facts can be well explained by supposing the projection in space of Professor Emerson Reynolds's zigzag curve to be a spiral. This figure is, however, inadmissible, inasmuch as the curve has to pass through a point neutral as to electricity and chemical energy twice in each cycle. We must therefore adopt some other figure. A figure of eight or lemniscate will foreshorten into a zigzag just as well as a spiral, and it fulfils every condition of the problem. Such a figure will result from three very simple simultaneous motions. First, a simple oscillation backwards and forwards (suppose east and west); secondly, a simple oscillation at right angles to the former (suppose north and south), of half the periodic time, *i.e.*, twice as fast; and thirdly, a motion at right angles to these two (suppose downwards), which, in its simplest form, would be with unvarying velocity.*

If we project this figure in space we find on examination that the points of the curves where chlorine, bromine, and iodine are formed come close under each other; so also will sulphur, selenium, and tellurium; again, phosphorus, arsenic, and antimony, and in like manner other series of analogous bodies.

It may be asked whether this scheme explains *how* and *why* the elements appear in this order? Let us imagine a cyclical translation in space, each revolution witnessing the genesis of the group of elements which I previously represented as produced during one complete vibration of the pendulum. Let us suppose that one cycle has thus been completed, the centre of the unknown creative force in its mighty journey through space having scattered along its track the primitive atoms, the seeds, if I may use the expression, which presently are to coalesce and develop into the groupings now known as lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, sodium, magnesium, aluminium, silicon, phosphorus, sulphur, and chlorine.

What is most probably the form of track now pursued? Were it strictly confined to the same plane of tempera-

* Put into their simplest mathematical dress, the first of these motions is represented by $x=a.\ \sin(mt)$, the second by $y=b.\ \sin(2\,mt)$, and the third by $z=c.t$.

ture and time, the next elementary groupings to appear would again have been those of lithium, and the original cycle would have been eternally repeated, producing again and again the same fourteen elements. The conditions, however, are not quite the same. Space and electricity are as at first; but temperature has altered, and thus, instead of the atoms of lithium being supplemented with atoms in all respects analogous with themselves, the atomic groupings which come into being when the second cycle commences form not lithium but its lineal descendant, potassium.

Suppose, therefore, the *vis generatrix* travelling to and fro in cycles along a lemniscate path as above suggested, while simultaneously temperature is declining and time is flowing on (variations which I have endeavoured to represent by the downward sink); each coil of the lemniscate track crosses the same vertical line at lower and lower points. Projected in space, the curve shows a central line neutral as far as electricity is concerned, and neutral in chemical properties—positive electricity on the north, negative on the south. Dominant atomicities are governed by the distance east and west from the neutral centre line, monatomic elements being one remove from it, diatomic two removes, and so on.*

In every successive coil the same law holds good. As the mighty focus of creative energy goes round we see it in successive cycles sowing in one tract of space seeds of lithium, potassium, rubidium, and cæsium; in another tract, chlorine, bromine, and iodine; in a third, sodium, copper, silver, and gold; in a fourth, sulphur, selenium, and tellurium; in a fifth, beryllium, calcium, strontium, and barium; in a sixth, magnesium, zinc, cadmium, and mercury; in a seventh, phosphorus, arsenic, antimony, and bismuth; in other tracts, aluminium, gallium, indium, and thallium; silicon, germanium, and tin; carbon, titanium, and zirconium; whilst a natural position near the neutral axis is found for the three groups of elements relegated by Professor Mendeléeff to a sort of hospital for incurables—his 8th family.

We have now traced the formation of the chemical elements from knots and voids in a primitive, formless fluid. We have shown the possibility, nay, the probability, that the atoms are not eternal in existence, but share with all other created beings the attributes of decay and death. We have shown, from arguments drawn from the chemical laboratory, that in matter which has responded to every test of an element, there are minute shades of difference which may admit of selection. We have seen that the time-honoured distinction between elements and compounds no longer keeps pace with the developments of chemical science, but must be modified to include a vast array of intermediate bodies—"meta-elements." We have shown how the objections of Clerk-Maxwell, weighty as they are, may be met; and, finally, we have adduced reasons for believing that primitive matter was formed by the act of a generative force, throwing off at intervals of time atoms endowed with varying quantities of primitive forms of energy.

If we may hazard any conjectures as to the source of energy embodied in a chemical atom, we may, I think, premise that the heat radiations propagated outwards through the ether from the ponderable matter of the universe, by some process of nature not yet known to us, are transformed at the confines of the universe into the primary — the essential — motions of chemical atoms, which, the instant they are formed, gravitate inwards, and thus restore to the universe the energy which otherwise would be lost to it through radiant heat. If this conjecture be well founded, Sir William Thomson's startling prediction of the final decrepitude of the universe through the dissipation of its energy falls to the ground.

In this fashion, gentlemen, it seems to me that the great question of the elements may be provisionally treated. Our slender knowledge of these first mysteries is extending steadily, surely, though slowly. Whilst certain ardent chemists are testing the commonly received view of the homogeneity of the elements by methods of fractionation, others, by means of the spectroscope, are carrying on another form of assault; each worker bent on the one idea of undermining the secret. I earnestly recommend such researches. However successfully pursued, they cannot, I know, lead directly to any results capable of being turned to industrial account. If, however, we consider the small but firm foothold we have gained in pursuit of this line of investigation, I venture to think there is reasonable ground to hope that these researches may tend to place chemistry upon a new foundation, by penetrating down through loose superficial matter to the solid rock.

The application of the luminous principle of evolution has re-modelled and vivified many branches of biology; and philosophers are eagerly invoking its aid in other departments of science; I would fain hope that I may not be deemed unduly sanguine in believing that the application of this regenerating principle to chemistry will produce far-reaching effects on its harmonious and progressive development.

* In the model curve, Fig. 2, the elements are supposed to follow one another at equal distances along the lemniscate spiral. The vertical scale is divided into 240 equal parts, on which the atomic weights are plotted, from H=1 to Ur=239. Each ball representing an element is accurately on a level with its atomic weight on the vertical scale. Metallic elements are silvered; it will be seen that with one or two exceptions all the metals are on the north side. Missing elements are represented black. A few doubtful elements—didymium, samarium, erbium, holmium, and thulium,—are inserted in the positions required by the atomic weights usually assigned to them; a glance, however, will show that they have no right to the places they occupy.

PHYSICAL SOCIETY.

May 26th, 1888.

Mr. Shelford Bidwell, F.R.S., Vice-President, in the Chair.

Mr. S. O. Roberts was elected a member of the Society.

The following communications were read:—

"*Note on the Governing of Electromotors.*" By Profs. W. E. Ayrton and J. Perry.

In a paper read before the Society of Telegraph Engineers in 1882 the authors deduced the conditions of self-regulation of electromotors for varying load when supplied either at constant potential or with constant current. The conditions involved "differential winding," *i.e.*, the use of a shunt motor with series demagnetising coils. With this arrangement fairly good regulation has been obtained, but owing to want of economy the methods have not been developed further. Since then another arrangement, in which a simple shunt motor is used and a few accumulators placed in series with the armature, has been devised for working in a constant current system. By means of a suitable switch the accumulators can be charged when the motor is at rest. On the assumption that the E.M.F. of motors is given by $E = n(p+tZ)$, where n = speed, Z = number of turns on magnets, and p and t are constants, it is shown that the speed at which a motor will govern is given by—

$$n = \frac{z+a+a'}{t}$$

and the constant current—

$$C = \frac{e-np}{a+a'}$$

where z and a are the resistances of the shunt and armature respectively, and e and a' the E.M.F. and resistance of the accumulators. Since a and a' may be small and np not large, the value of e need not be great to give a considerable value for C, and thus only a small number of accumulators will be required.

"*On the Formula of Bernoulli and Haecker for the Lifting-power of Magnets.*" By Prof. S. P. THOMPSON, D.Sc. Read by Prof. PERRY.

The formulæ referred to are $P = a\sqrt[3]{W^2}$ and $P = a\sqrt[3]{W^2}$ respectively, where P = lifting-power, W = mass of magnet, and a a constant depending on the material and shape of the magnet. These formulæ the author shows are equivalent to saying that that the lifting-power of magnets in which the magnetic induction, B, has been carried to an equal degree, is proportional to the polar surface, and that Haecker's coefficient, a, is proportional to B^2 through the surface. Assuming the induction uniform over the surface it is shown that—

$$P = \frac{1}{8\pi} B^2 A$$

where A = area of surface, and this gives a very convenient method of determining B from measurements made upon the pull exerted at a given polar surface. If P be measured in kilos. and A in sq. c.ms. the formula for B becomes—

$$B = 5000\sqrt{\frac{P}{A}}$$

and if the measurements be made in lbs. and inches the constant becomes 1317.

It will be readily seen that the greater power of small magnets in proportion to weight does not require for its explanation the sometimes alleged fact that small pieces of steel can be more highly magnetised than large ones, for if B be the same, the lifting-power will be proportional to the polar surface, and not to weight, and hence must necessarily be greater relatively to weight in small magnets. In the case of electromagnets for inductions between 6000 and 16000, between which the permeability, μ, is approximately given by—

$$\mu = \frac{16000 - B}{3{\cdot}2}$$

the lifting power is shown to be—

$$P = A\left(\frac{3{\cdot}2\,Si}{Si + 2{\cdot}56\,l}\right)^2$$

where P is in kilos, A in square centimetres, Si = ampere turns, and l = mean length of the magnetic circuit.

"*Experiments on Electrolysis. Part* II. : *Irreciprocal Conduction.*"* By Mr. W. W. HALDANE GEE, B.Sc., and Mr. H. HOLDEN, B.Sc.

An abstract was read by the Secretary.

The authors have observed, when strong sulphuric acid is used as an electrolyte, the electrodes being of platinum, that the decomposition nearly ceases if, by decreasing the resistance in circuit, it is attempted to increase the current beyond a certain maximum. When this condition (called the insulating condition) is arrived at, reversing the current immediately restores the conductivity. Experiment shows that the current density is an important factor, and that the composition, viscosity, and temperature of the electrolyte, as well as the previous history of the electrodes, have considerable influence on the current density at which the insulating condition occurs. The seat of the insulating layer is found to be at the anode, and the authors believe it due to very concentrated acid formed around the electrode, whose specific resistance is very high. Experiments were also made with carbon and gold electrodes, and phosphoric acid, caustic potash, soap, and sodium benzoate were used as electrolytes, the results of which seem compatible with the concentration hypotheses above stated.

The paper contains an historical and critical account of allied phenomena, and tables expressing the numerical results obtained by the authors are given.

* Irreciprocal conduction is said to occur if a reversal of the direction of a current causes any change in its magnitude.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, June 4, 1888.

His Grace THE DUKE OF NORTHUMBERLAND, K.G., D.C.L., LL.D., President, in the Chair.

THE following were elected Members of the Royal Institution :—

F. W. Bayley, F.C.S., Jacob Feis, Charles Albert Flint, Arthur Holland, Mrs. John Mackinlay, and Thomas Woolner, R.A.

The special thanks of the Members were returned to Professor W. Chandler Roberts-Austen, for his present of a Portable Assay Furnace.

The presents received since the last meeting were laid on the table, and the thanks of the Members returned for the same.

NOTICES OF BOOKS.

Nature's Hygiene : A Systematic Manual of Natural Hygiene, containing a Detailed Account of the Chemistry of Eucalyptus, Pine, and Camphor Forests and Industries connected therewith. By C. T. KINGZETT, F.I.C., F.C.S. Third Edition. London : Baillière, Tindall, and Cox.

THE preface to this third edition of Mr. Kingzett's work contains a passage which deserves the most careful attention. Says the author, justly and pertinently :— "While the development of chemical science in recent years has been most marked, sanitary authorities have not sufficiently availed themselves of its services, but have relied much too confidently upon mere engineering skill. The disposal of the London sewage as at present effected will serve to exemplify my meaning, and may be taken by way of illustrating the disastrous results that may ensue from such an unfortunate reliance. The water-carriage system of sewage has grown in London from a blessing into an unmitigated and terribly costly evil."

This passage, it may be said, gives the key-note to that part of the work before us which discusses general sanitation. Thus, in considering the great question of water-supply, he does not accept the sweeping dictum of the River Commissioners that "Rivers which have received sewage, even if that sewage has been purified before its discharge, are not safe sources of potable water." He examines the evidence of Dr. Tidy, Prof. Odling, Dr. Pehl, Mr. Sorby, and Dr. Hogg, and he disposes very fairly of the so-called "Caterham case." He quotes also the important experiment conducted by Mr. Crookes and Drs. Odling and Tidy, which showed that the germs of splenic fever, after eighteen hours' of contact with large volumes of water, become incapable of propagation. He considers it necessary, however, that no untreated sewage should be allowed to enter the Thames.

He notes the absence of paper in the sewage at the London outfalls and refers to its comminution. That it is so comminuted and that it forms a sparingly pervious layer on the surface of filter-beds and sewage-fields is no "theory" devised by Dr. Tidy or by any one else, but a fact which has been known for years to persons practically conversant with the treatment of sewage.

The attempts to deodorise the Thames by the addition of chloride of lime and potassium permanganate he considers futile, the cost being stupendous and the effect far too little.

Having condemned the system of sewage disposal as carried out in London, and that with good grounds, he turns to irrigation. He admits that "given suitable ground, of sufficient extent, and in dry weather we can by irrigation very completely purify sewage." But he holds, very justly, that we have not a sufficiency of land available

for this purpose, whence irrigation cannot be accepted as "an exclusive means of purifying sewage."

Precipitation processes are judged very fairly, though we cannot accept without questioning the opinion that the cost of the chemicals employed is much greater than the increased value given to the product.

Into the remainder of this valuable book we cannot here enter. But we must venture to ask why do sanitarians confine their attention to the so-called zymotic diseases? Is it not true that the diseases of debility, phthisis, albuminuria, affections of the heart and brain, which are always active in our midst, are largely caused by human folly, and are therefore preventible? But we are doubtful as to the reception which might fall to the lot of the author or lecturer who should point out some of the causes of these affections. Mr. Kingzett's work, meantime, deserves our warm commendation, and we are glad that the present edition has been found necessary.

Merchandise Marks Act, 1887: Being an Act to Consolidate and Amend the Law on Fraudulent Trade-Marks. A Complete Digest of its Sections, with Definitions thereof. By H. C. RICHARDS, Barrister-at-Law, and HENRY SMITH (Messrs. Stapley and Smith), together with the Regulations made by the Commissioners of Customs, &c., &c. Reprinted from the *Warehousemen and Drapers' Trade Journal*. London: *Warehousemen and Drapers' Trade Journal* Office.

THE necessity for the Act here discussed is very generally admitted, save by the very persons whose doings it was intended to repress. We understand that goods manufactured abroad have been systematically branded with the names and trade-marks of well-known British firms, and sold as of British make not merely in neutral markets, but even in this country. It is even said that with the obvious purpose of bringing British manufacturers into discredit such trade-marks have been attached to very inferior articles. We are told that the name "Sheffield" has been bestowed upon a new suburb of a foreign manufacturing town in order that cutlery made there might, with technical truth, be warranted as of "Sheffield make." To interfere with such practices in neutral markets is, of course, beyond the power of Government; but so far as the United Kingdom is concerned, the present Act seems likely to have a wholesome effect. That such will be the case seems probable from the outcry raised against it in certain quarters, but we do not see that it can occasion any hardship to the honest trader.

The work treats of offences under the Act, of penalties and methods of procedure, of the nature of trade-marks and trade descriptions. Further sections deal with forged marks, exemptions, watch marks, evidence, accessories, search warrants, limitations as to prosecutions, imported goods, and royal warrants.

The bulk of the treatise is taken up with a digest of the Act, in which explanatory matter is interposed. As far as we can judge the authors will have rendered no small service to traders who wish to conform with the provisions of the law as it now stands.

Journal of the Royal Agricultural Society of England. Part I. of Vol. xxiv. April, 1888.

AMONG the memoirs here comprised we notice one by Mr. R. Valentin, on the "Practical Value of Dung as compared with Artificial Manures." The author combats the still existing prejudice in favour of dung and against chemical manures. He declares that dung, even when containing a good percentage of nitrogen, due to costly feeding-stuff, seldom shows such favourable results in the crops as artificial manures, which contain their nitrogen in a more readily available form. Chemical manures have hitherto, he admits, produced crops of both corn and roots fully better than dung. In making dung from dear food and applying it to the land there is a considerable loss. The residue left after assisting one crop suffers loss from the rains in winter.

The "Report of the Consulting Entomologist," Miss E. A. Ormerod, F.E.S., F.R. Met. S., though of great value, can scarcely be said to fall within our scope. Much the same holds good concerning the "Report of the Consulting Botanist," Mr. W. Carruthers, F.R.S., P.L.S., who shows that farmers are imposed upon to no small extent by the adulteration of seeds.

The Consulting Chemist, Dr. J. A. Voelcker, has been much engaged with spurious feeding cakes. He points out that the favourite material used by sophisticators is rape-refuse, *i.e.*, rape-seed from which the oil has been withdrawn not by pressure but by solvents. This fraud is not to be detected with certainty by chemical means. In a sample thus adulterated to the extent of 30 per cent there is no one point upon which the chemist can rely as conveying definite evidence of the fraud. Hence careful systematic examination with the microscope becomes necessary. In addition to rape linseed cake may contain cockle-seed, mill-sweepings, niger-seeds, locust beans, and hemp-seed.

Cotton-seed cake appears to have fallen off in quality, so far as its most valuable constituent, the oil, is concerned.

Three samples of sewage sludge have been examined. One of them contained 34 per cent of sand, with 43 per cent of moisture. The specimen which Dr. Voelcker designates as the best contained 10·82 per cent of sand, 45·45 of moisture, and 24·43 of carbonate of lime. Such products will do little to raise the reputation of sewage manures. The experiments tried with basic slag have been inconclusive, owing to the dryness of the season.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 21, May 22, 1888.

The Part played by Nitrogen in Vegetable Economy.—E. Chevreul.—The author points out that as far back as 1854 M. Georges Ville announced the same views on the fixation of nitrogen by plants as those which have been subsequently published by MM. Gautier and Drouin. In 1854 a Commission composed of MM. Dumas, Regnault, Decaisne, Peligot and the author, after a series of careful experiments, decided in favour of M. Ville as against M. Boussingault.

Determination of the Combustion-heat of a New Solid Isomer of Benzene.—W. Louguinine,—The combustion-heat of this novel compound is 847,384 cals., that of normal benzene being only 776,000 cals.

The Neutralisation-heats of Cyanomalonic Ether, Acetyl-, and Benzoyl-cyanacetic Ether.—Alb. Haller and A. Guntz.—This thermo-chemical memoir does not admit of useful abstraction.

Zeitschrift fur Analytische Chemie. Vol. xxvi., Part 5.

Distinction between Citric Acid and Tartaric and Malic Acids.—Mean.—The author heats the acid with 0·7 glycerin until vapours of acrolein are evolved, takes up the mass in a little ammonia, the greater part of which is then expelled by heat. He then adds 2 drops of nitric acid (fuming acid diluted with 5 parts of water). Citric acid takes a green colour, which turns blue on heating. The two other acids do not show this reaction.

Detection of Small Quantities of Hydrocyanic Acid.—G. Vortmann.—The liquid in question is mixed with a few drops of a solution of potassium nitrite, 2 to 4 drops of solution of ferric chloride, and dilute sulphuric acid enough to turn the yellowish brown basic ferric salt first formed to a light yellow. It is then heated to incipient ebullition, mixed with a few drops of ammonia to precipitate the excess of iron, filtered, and the filtrate is tested with 1 to 2 drops of very dilute, colourless ammonium sulphide. If hydrocyanic acid was originally present the solution takes at once a violet colour, which changes into blue, green, and finally into yellow. If the quantity of hydrocyanic acid is very small, a bluish green colour is produced at once.

Cyclamose.—G. Michaud.—From the *Bulletin de la Soc. Chimique.*

Action of Potassium Permanganate upon Glucose.—A. Smolka.—Part of the sugar remains unchanged, whilst the rest is converted into water, carbon dioxide, and oxalic and acetic acids.

The Alkaloids of the Barberry.—E. Schmidt.—From the *Archiv. der Pharmacie.* No particulars are here given.

On a New Volatile Alkaloid Arecan.—E. Bombelon.—This base is obtained from the betel nut. Its hydrochlorate gives a yellow precipitate with platinum chloride, a light yellow with gold chloride, a white with mercuric chloride, and a whitish with tannin.

On Sparteine. — Grandval and Walser.— From the *Journal de Pharmacie et Chemie.*

Characteristic Reactions of Hydrastine.—A. B. Lyons.—From the *Druggists' Circular.*

On Ulexine.—A. W. Gerrard.— From the *Pharm. Journal.*

The Jodlbauer Modification of the Kjeldahl Nitrogen Process.—A. Stutzer and O. Reitmar.—Both with pure nitres and with nitriferous manures the authors obtained results accurate to within a few hundredths of a per cent by attending to the following points. The nitrate or the nitriferous manure must be submitted to the action of the phenol-sulphuric acid in a very fine state of division. They weigh out 1 grm. of the nitriferous manure, cover it with 25 c.c. of water, and evaporate it down at 100° to 110°. To the dried mass they add 50 c.c. of a sulphuric acid containing, per litre, 20 grms. phenol, let it stand for some minutes with occasional agitation, add 2 to 3 grms. zinc powder free from nitre, and 1 to 2 drops of mercury, and heat to a boil. In an hour and a half the conversion into ammonium sulphate is complete.

Volumetric Determination of Alkaloids with Mayer's Reagent (Potassium-mercury Iodide).— F. S. Hereth.—Fifty c.c. of the solution of the extract are mixed with acidulated water and cautiously evaporated at a gentle heat to drive off alcohol. Any matter deposited is filtered off and the filter is washed with acidulated water. The liquid, which should contain about 1 per cent of free sulphuric acid, is made up to 100 c.c. Eight portions of 10 c.c. each are measured into test-tubes with a pipette, and the quantity of Mayer's liquid required for 10 c.c. is determined by a preliminary experiment on the rest of the liquid. Supposing that this is about 3 c.c., we add to the respective portions 2·7, 2·8, 2·9, 3, 3·1, 3·2, 3·3, and 3·4 c.c. each, let them stand, closed for eight hours, pour the supernatant liquid into eprouvettes, and add to each 0·1 c.c. of the Mayer solution. In one to two minutes it can be seen in which portion no further deposition takes place.

Determination of Tartaric Acid in Wine Lyes.—V. Olivier.—From the *Bulletin de la Société Chimique.*

Determination of Inverted Sugar in Crude Sugar.—F. Wolf.—From the *Zucker Industrie.* The method approximates to that of Patterson and Biggart.

Cider and Apple Vinegar.—W. F. Smith.—From the *Journal of the American Chemical Society.*

Chemical Reaction for Cholera Bacteria.— Odo Bujwid.—When the colonies are grown up to small white points, such a point is placed in beef-broth and cultivated for twelve hours at 37°. If cholera bacilli are present the liquid, on the addition of 5 to 10 per cent of ordinary hydrochloric acid, takes a faint rose-violet colour.

Detection of "Wild Mace" or "Bombay Mace" in Ground Mace.—R. Frühling.—From the *Chemiker Zeitung.*

Determination of Carbon Disulphide in Benzol and Crude Naphthol.—Ph. Holland and Harcourt Phillips.—From the *Journal of the Society of Chemical Industry.*

Detection of Mineral Oils in Pine Oil.—Finkener.—The author treats the sample in question with 10 vols. of a mixture of 10 vols. alcohol (sp. gr. 0·8182 at 15·5°) and 1 vol. chloroform. Pure pine oils dissolve in this mixture, whilst mineral oils do not dissolve even in 100 vols.

Analysis of Explosives.—G. Lunge.—This paper requires the accompanying figure.

Examination of Commercial Quinine Sulphate.—A bulky article taken in great part from the *Pharmaceutical Journal*, the *Journal de Pharmacie*, the *Chemist and Druggist*, and the CHEMICAL NEWS.

Detection of Peptone in Blood.—Georges gives two processes, the first proposed by Wassermann and the second by Tanret.

Detection of Carbon Monoxide in Blood.—According to Gruber the method of Fodor gives good results if the blood be taken in hand at once, but after some hours it does not succeed, as the carbon monoxide is oxidised by the oxy-hæmoglobine.

Detection of Mercury in Urine and Animal Liquids. A. Almén.—The author proposes a modification of the process of Reinsch.

The Reducing Substances in Diabetic Urine.—The figures found by titration point to a higher proportion of sugar than those found by polarisation or by fermentation.

A Novel Pathological Pigment in Urine. — W. Leube.—This pigment was found in the urine of an osteomalacic subject. It dissolves in ether with a reddish violet colour. It shows no characteristic absorption-band.

The Spectral Behaviour of Certain Colouring-matters Physiologically and Clinically Interesting.—C. Crukenberg.—An examination of the spectra of the blue and red colouring-matters obtained from tilirubine, the spectra of hydrocyanic-oxyhæmatine, hæmatoporphyrine, and other animal colours. The details are not given.

Detection of Blood-pigment in Urine.—L. Lewin and C. Posner.—In bloody urine the spectral detection of methæmoglobine and hæmatine is practicable only in such thick strata that the entire spectrum is extinguished up to the red.

MISCELLANEOUS.

Hofmann Testimonial Fund.—We are informed by Mr. J. Spiller, Hon. Sec. for Great Britain, that the sum total subscribed in the United Kingdom towards the Hofmann Testimonial amounted to £256 8s. 6d. : which, after deducting the expenses of printing and postage, and retaining until now a small balance for contingencies, was transmitted to Berlin on the 31st March, by the Chairman, Sir Frederick Abel. We give below a translation of the letter of acknowledgment which Professor von Hofmann has addressed to Dr. C. A. Martius, secretary of the central committee, expressing his deep sense of gratitude to all the subscribers for the honour paid him in the celebration of his 70th birthday, and indicating the nature of the application which he proposes should be made of the

fund which has been collected. The Emperor of Germany has conferred upon Professor Hofmann the rank of Privy Councillor and a title of nobility, and both the Empress of Germany and Her Majesty Queen Victoria joined in offering congratulations on the occasion of his birthday. His Highness the Comte de Paris headed our subscription list with a donation of £20, and the contributions sent in from many foreign countries attest to the wide-spread appreciation of the movement, and the desire to do honour to the Professor. Details with respect to the disposal of the money are given in the accompanying letter.

(*Translation*).

"Berlin, May 18th, 1888.

"Dear Sir,—Allow me in the first place to repeat in writing the expression of the deep sense of gratitude, which I have already verbally conveyed to you and your friends on the occasion of your presenting me with the splendid marble bust from Schaper's hand, and with the artistic address announcing the intention of creating a Hofmann Foundation. May I ask you to act as my interpreter towards those who generously combined with you to impart so auspicious a character to the celebration of my 70th birthday. I am naturally anxious to let the subscribers to the foundation know how I think the abundant means placed at our disposal should be made use of. First of all, you will permit me to make up the amount to 50,000 marks from my own resources. The interest of this sum I propose to apply to the advancement of experimental research in chemistry. I am at present occupied with the working out of a statute regulating the mode of this application, and hope before long to acquaint you with its tenour. Two important principles which will be embodied in it may, however, be mentioned even now:—(1.) It must remain with the council of the German Chemical Society to decide in each case how this advancement may best be realised. (2.) This advancement, whatever form it may take, must be free from any limitation of a national character. As soon as the statute for the foundation shall be in a measure elaborated, I propose to lay it before the council of the German Chemical Society, and after arriving at an understanding with them, I shall submit it to you, so that before it receives its final form the opinions of those may be heard by whose efforts the foundation has been created.—Accept, dear Sir, the expression of my grateful regards, and believe me, yours very sincerely, (signed) A. W. HOFMANN.—To the President of the Committee for the Establishment of a Hofmann Foundation, Dr. C. A. Martius, Berlin."

NOTES AND QUERIES.

Zinc Chloride.—I should feel obliged if any correspondent could inform me if zinc chloride is used commercially in large quantities, and in what manufacture or manufactories it is used.—Q. R. V.

History of Chemistry as Known to the Ancients.—Will any correspondent kindly supply name of any English or foreign publications which treat upon chemical knowledge derived from Greek and Latin, Babylonian, Jewish, Scandinavian or Icelandic, Gothic, Persian, Arabian, and Ancient American authorities, even Assyrian Tablets, and the Chinese and cognate nationalities? Reference thereto would no doubt assist the undersigned very much.—GERTRUDE AMBURGER.

Alcohol in Water.—I am one of those unfortunate individuals who does not file his CHEMICAL NEWS, and consequently frequently finds himself inconvenienced accordingly. Some two years ago I read a report of some experiments on alcohol in natural waters in this journal, I believe by Dr. Dupré, showing that natural waters contain a minute trace of alcohol. Could any of your correspoudents inform me of the number in which it appeared, or whether it is published in book or pamphlet form?—DELPH.

MEETINGS FOR THE WEEK.

TUESDAY, 12th.—Royal Medical and Chirurgical, 8.30.
—— Photographic, 8.
WEDNESDAY, 13th.—Microscopical, 8.
THURSDAY, 14th.—Mathematical, 8.
—— Royal, 4.30.
SATURDAY, 16th.—Royal Institution, 3. "Count Tolstoi as Novelist and Thinker," by Professor C. E. Turner.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1490.

THE CONDITIONS OF THE EVOLUTION OF GASES FROM HOMOGENEOUS LIQUIDS.*

By V. H. VELEY, M.A., University College, Oxford.

This paper is conveniently divided into three parts. In part (i.) an account is given of the effect of finely divided particles on the rate of evolution of gases resulting from chemical changes; in part (ii.) the phenomenon of initial acceleration, as also the effect of variation of pressure on the evolution of gases, is discussed; in part (iii.) the case of the decomposition of formic acid into carbonic oxide and water is investigated under constant conditions, other than those of the mass of reacting substances and of temperature.

Part I.—It is found that the addition of finely divided chemically inert particles increases the rate of evolution of gases from liquids in which they are being formed. The effect of these particles on the following chemical changes is investigated: (i.) the decomposition of formic acid yielding carbonic oxide; (ii.) the decomposition of ammonium nitrite in aqueous solution yielding nitrogen; (iii.) the reduction of nitric acid into nitric oxide by means of ferrous sulphate; (iv.) the decomposition of ammonium nitrate in a state of fusion producing nitrous oxide; and (v.) the decomposition of potassium chlorate in a state of fusion producing oxygen. The finely divided substances used are pumice, silica, graphite, precipitated barium sulphate, and glass-dust.

Part II.—It is observed that, conditions of temperature remaining the same, the rate of evolution of a gas from a liquid is at first slow, then gradually increases until it reaches a maximum and for some time constant rate. From this point the rate decreases proportionally to the diminution of mass. This is observed in the cases of the decomposition of formic acid, potassium ferrocyanide, and of oxalic acid by concentrated sulphuric acid, and in that of ammonium nitrate. It has previously been observed in the case of the decomposition of ammonium nitrite in aqueous solution. The same phenomenon repeats itself when the temperature is temporarily lowered and then raised to its former point, and also to a more marked degree when, temperature remaining the same, the superincumbent pressure is suddenly increased.

The reduction of pressure from one to a fraction of an atmosphere produces no *permanent* effect on the rate of evolution of a gas from a liquid; a decrease of pressure, however, produces *temporarily* an increase in the rate, and an increase of pressure conversely produces *temporarily* a decrease in the rate.

Part III.—The case of the decomposition of formic acid into carbonic oxide and water by diluted sulphuric acid is studied with the aid of an apparatus by means of which the temperature is kept constant within one-twentieth of a degree. It is shown that the rate of evolution of carbonic oxide is expressible by the following equation:—

$$\log (\tau+t) + \log r = \log c,$$

in which τ is the time from the commencement of the observations; t is the interval of time from the moment of commencement, and that at which, conditions remaining the same, the interval of time required for unit change would have been *nil*; r is the mass at the end of each observation, and c is a constant. The results calculated by this hypothesis agree with those observed, whether the interval of time required for unit change is thirty or nine hundred and sixty minutes. The curve expressing the rate of chemical change in terms of mass is thus hyperbolic and illustrative of the law—

$$\frac{dr}{d\tau} = -\frac{r^2}{c},$$

which expresses the rate at which equivalent masses act upon another; $1/c$ in each experiment is the amount of each unit mass which reacts with the other per unit of time, when a unit mass of each substance is present. Since then equivalent masses take part in the change, it is reasonable to suppose that at first an anhydride of formic acid is produced thus:—

$$\left.\begin{matrix}HCO\\H\end{matrix}\right\}O + \left.\begin{matrix}HCO\\H\end{matrix}\right\}O = \left.\begin{matrix}HCO\\HCO\end{matrix}\right\}O + H_2O.$$

The anhydride is unstable, and is subsequently decomposed into carbonic oxide and water,

$$\left.\begin{matrix}HCO\\HCO\end{matrix}\right\}O = 2CO + OH_2.$$

The change may thus be compared to the production of ethyl formate from formic acid and alcohol,

$$\left.\begin{matrix}HCO\\H\end{matrix}\right\}O + \left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}O = \left.\begin{matrix}HCO\\C_2H_5\end{matrix}\right\}O + H_2O,$$

with which it shows several points of analogy.

In the original paper the methods of observation and the apparatus used are described in full, and the results obtained are set forth in a series of tables.

* Abstract of a Paper read before the Royal Society, May 31st, 1888.

VOLUMETRIC DETERMINATION OF BROMINE.

By JOHN TSAWOO WHITE.

Bromine is evolved on heating a bromide with potassium permanganate and aluminium sulphate. Chlorides and iodides do not give off chlorine or iodine. Solutions of potassium chloride, bromide, and iodide were prepared, and their strengths determined by silver solution.

The solution, mixed with 1 grm. permanganate and 5 c.c. of a solution of aluminium sulphate saturated at ordinary temperatures, is diluted to about 50 c.c. in the distilling flask. The bromine is distilled in a current of carbon dioxide into a solution of potassium iodide, and the liberated iodine is determined by decinormal thiosulphate.

Only five-eighths of the bromine is given off, so that the bromine found × 1·6 will give the total bromine. The factor 1·6 obtained from the present experiments might be done away with or modified by future experiments. A re-distillation after 30 hours of the remainder of the solution of the fourth experiment gave but a trace of bromine. Trials of the mixed solutions were made to notice any modifying action. The results are as below. The atomic weights used in calculations are those given in Roscoe and Schorlemmer's treatise.

Taken.	Found.
0·0031 Br	0·0028 Br
0·0157 Br	0·0152 Br
0·0315 Br	0·0307 Br
0·0621 Br	0·0616 Br
0·0315 Br + 0·0229 I + 0·0439 Cl	0·0307 Br
0·0031 Br + 0·1145 I	0·0028 Br
0·0031 Br + 0·0439 Cl	0·0028 Br

Whatever the reaction is that takes place, the results are evidently constant.

Rangoon College, May 14, 1888.

Professor Williamson.—The portrait of Professor Williamson which is to be presented to University College is, we understand, to be painted by the Hon. J. Collier.

NOTES ON THE ROCK-SALT MINES OF PETITE ANSE, LOUISIANA.

By H. CARRINGTON BOLTON, Ph.D.

(Abstract).*

The southern coast of Louisiana, west of the Mississippi River, is indented by several bays through which the waters of innumerable bayous pass into the Gulf of Mexico. Near the head of one of these bays, known as Vermilion Bay, there is a nearly circular island of about 2500 acres in extent, which rises above the low marshes of the vicinity to the height of 180 feet, forming a notable feature in the monotonous landscape. This is the well known island of Petite Anse, also called Avery's Island after its present owners, in which occurs a remarkable deposit of rock-salt. Petite Anse is now easily reached by rail, *via* the Southern Pacific Railroad, from New Orleans as far as New Iberia (about 125 miles), and thence, by a branch road, 10 miles long, to the salt mine. Cotton and sugar plantations, uncultivated fields, marshes, cornfields, and cypress swamps alternate with luxurious forests of live-oak, gum, hickory, black walnut, cypress, maple, and magnolia. About two-thirds of the island are under cultivation, the most profitable crops being sugar, salt, and Tobasco pepper-sauce. Three ranges of hills can be traced, the surface water from which has cut its way deeply through the alluvial deposits, forming ravines, which, with ponds, forests, and cultivated fields, make the island a picturesque oasis in a wilderness of marsh and cypress swamps.

The existence of salt on this island has been known for a very long time, as shown by the fragments of pottery, arrow-heads, and basket work found mixed with bones of the mastodon, buffalo, and deer, unearthed in recent excavations. The written history of the deposit begins with 1791, when John Hays found a brine spring while hunting. In the last century, salt was made by boiling down the brine, and between the years 1812 and 1815 the amount produced was large. It then ceased for a time. Later, Judge D. D. Avery became owner of the island, and at the outbreak of the rebellion renewed operations on a large scale; the blockade made the salt exceedingly valuable, so that one time a bag of salt was exchanged for a bale of cotton. On May 4th, 1862, Mr. John Marsh Avery attempted to deepen a brine pit, and struck rock-salt at a depth of 16 to 17 feet below the surface. The Confederate Government then instituted mining by means of pits, and, 400 to 600 men being constantly employed, the island was a scene of prodigious activity. The Northern troops, however, seized the island April 20th, 1863, and put a stop to the industry. During these eleven months, about 22 million pounds of salt are estimated to have been taken out, the average price being 4½ cents per pound.

The first scientific observer who visited the deposit after these events was Professor Richard Owen in November, 1865 (*Am. Journ. Science*, July, 1866, p. 120). In 1866, Professor Charles A. Goessmann visited the place on behalf of the American Bureau of Mines ("Report of the American Bureau of Mines on the Rock-salt Deposit of Petite Anse," 4to., New York, 1867), and one year later it was examined by Professor E. W. Hilgard of the Geological Survey (*Am. Journ. Science*, Jan., 1869, and "Mineral Resources of the United States," Albert Williams, Jr., Washington, 1883).

To the reports of these gentlemen we owe some of the particulars of this notice.

The rock-salt lies only fifteen to twenty feet beneath the surface. The surface soil is a dark loam, beneath which occur layers of coarse and fine sand, gravel, and clay, all irregularly stratified and in no definite direction. The salt itself occurs as a massive crystalline rock of a saccharoidal texture, dry, hard, and homogeneous. It is of a white colour, except in streaks or bands two to six inches in width, which are quite black. The salt appears to have a uniform character in all parts of the mine, and is remarkable for its purity, especially in its freedom from calcium and magnesium salts. It is also quite free from potassium salts; for traces of Stassfurt salts I made especial search in vain. The following analyses show the great purity of this product:—

	Analysis by Mr. F. W. Taylor, (Smithsonian Institution), March, 1882.	Analysis by E. W. Hilgard. 1863.
Sodium chloride	98·731	99·880
Calcium sulphate	1·192	0·126
Calcium chloride	trace	trace
Magnesium chloride ..	0·013	
Silica	0·024	100·006
Iron sesquioxide	0·010	
Water	0·030	
	100·000	

Other analyses made by Professor Goessmann range from 98·88 to 99·60. It is of interest to compare this with rock-salt from other localities.

	Cheshire.	Stassfurt.	Berchtesgaden.
Sodium chloride	98·30	94·57	99·85
Potassium chloride ..	—	—	trace
Calcium chloride	—	—	trace
Magnesium chloride ..	0·05	0·97	0·15
Calcium sulphate	1·65	0·89	—
Insoluble	—	3·35	—
Water	—	0·22	—
	100·00	100·00	100·00

Partial analyses of the black salt have been made by Mr. McCalla, the resident engineer and chemist, who finds that it yields a white solution and about seven per cent of a white insoluble residue, chiefly gypsum. The black colour, therefore, seems to be an optical phenomenon. These black bands form well-marked folds in the salt, the space between the ridges and above them being filled with coarser granules of salt than the rest. Near these black bands the finest cleavage crystals of transparent purity are found. These bands seem to indicate that at some time the rock mass has been subjected to lateral pressure, causing ridges.

The geological features of the island and the origin of the salt deposit have been discussed by both Professor Goessmann and Professor Hilgard. The former thinks it is "probably of tertiary age," and says, "many circumstances favour the theory that the deposit is a secondary one—resulting from the evaporation of brine springs, originating from beds of rock-salt in some older geological formation—and not a direct residuum of the sea. This explains the entire absence of intercalations of gypsum and the absence of potassium and magnesium compounds."

Professor Hilgard thinks it should be assigned to the cretaceous, since there is "no phase of the tertiary history of the Gulf of Mexico that seems to admit of" the conditions required, viz., the long-continued evaporation of some very large body of sea-water. He calls attention to the banded structure of the rock-salt, and remarks that the "Stassfurt salts" belonging to the salt mass have long ago been washed into the general ocean.

We would call the attention of geologists to two facts which may throw light on the questions: the occurrence on the island of bedded sandstone and of lignite. The sandstone is exposed at the bottom of a deep ravine about 1500 feet from the shaft, the rock is of a light grey colour and contains little or no calcite. It is distinctly seen to be in place, and is weathered to a considerable depth beneath the surface. At the base of another ravine, formed

* Read before the New York Academy of Sciences, Feb. 13th, 1888. From *Transactions of the New York Academy of Sciences*, vol. vii.

by a rivulet cutting through the alluvium, gravel, and sand, and at a distance of about 2000 feet from the shaft, there is an outcrop of lignite. The latter is apparently several feet in width and of good quality for economic purposes. Mr. McCalla reports that it contains fifteen per cent of ash. Both the sandstone and the lignite seem to dip in such a direction (S.E.) as would cause them to run beneath the salt. This view is also confirmed by some of the borings. Indications of fossil plants occur in the brown coal, but at the time of my visit it was unfortunately impracticable to dig deeply into it, and I had to be content with a mere surface specimen.

There are four other islands stretching along the coast in the vicinity, but borings have failed to reveal salt on any of them.

The mine is now worked by a system of chambers and cross-headings. The single shaft has reached a depth of 166 feet (including the sump of 6 feet). The old workings at a depth of 90 feet have been abandoned, owing to the infiltration from above of water carrying with it clay and sand, which rendered the salt impure. The lower level is at a depth of 160 feet. The extent of the excavation in the upper level is about 8 acres, and the extreme ends of the galleries are 900 feet apart. The excavation on the lower level is much smaller. The method of operating is to run galleries about 6 to 8 feet high, and then to work upward to a height of 40 feet, leaving between the galleries large pillars to support the roof. The boring is done with a kind of auger of a German pattern, imported in deference to the prejudices of the workmen, who are largely Stassfurt miners. The auger is worked by hand and penetrates the salt one inch for every twelve revolutions of the bit. The blasting is done with dynamite, of which 80 to 100 boxes, each containing 100 lbs., are used every month, say on an average 150 lbs. daily.

After blasting down 40 feet the salt is broken by sledges, placed in small hand carts, and hoisted on a platform to the surface by steam power. About one hundred men are employed by the company, of whom fifty work below the surface. They work on ten-hours time.

The rock mass is quite dry, but, owing to bad management in the early history of the mine, water from the surface runs into it through seams and openings; to remove this two pumps, capable of throwing out 100 gallons per minute, are run about ten hours out of the twenty-four. The brine pumped out is allowed to waste.

Ventilation is necessitated by the great quantity of dynamite exploded daily. Air is supplied by a fan 8 feet in diameter, 4 feet wide, driven at about 250 revolutions per minute. This, it is estimated, supplies about 600,000 cubic feet of air per hour.

Pockets of an inflammable gas have been repeatedly struck, and on a recent occasion the issuing gas was lit and burnt for an hour or more. Perhaps this phenomenon is connected with the underlying lignite.

The engines used for running the blower, the fan, reels, breakers, &c., are three in number, and aggregate 250 horse-power.

The salt brought to the surface is crushed between corrugated rollers driven at high speed; one set breaks it into lumps from two to three inches in diameter, and another into lumps one-half inch in diameter and finer. It is then ground into various grades by six buhr-stone mills, each capable of grinding 50 tons in ten hours. The salt is sorted by jigs, revolving reels, and blowers, the fine dust being blown out by a horizontal current of air striking against a column of falling salt.

The salt is sent into market in eight grades:—(1) Rock-salt in lumps from 100 to 300 pounds, used by farmers, it being placed under sheds for cattle to lick. (2) Crushed salt that passes over ½-inch screens and through ¾-inch screens. (3) "Fish salt," including all which passes through a ½-inch screen. (4) Coarse ground. (5) Medium ground. (6) Fine ground. (7) For sack and barrel salt the coarser particles of grade 6 are screened out with a wire screen of ten meshes to the inch, and the fine dust is blown out. (8) The fine dust thus blown out divides itself by gravity into an impalpable part (which is thrown away, being a small percentage) and a coarser part, which forms table salt. The salt is shipped to market in sacks and barrels.

For the year ending July, 1887, the product was 44,000 tons. In a busy season the daily shipments run as high as 300 tons. Formerly the material was transported by water, through a canal expressly maintained for the purpose, into the bay, some miles distant; now the railway carries it exclusively.

The amount of salt in sight is very great, and the possible extent of the deposit is enormous. Borings show that about 142 acres of ground are underlaid with salt, the extreme depth of which has not been ascertained, though borings have been sunk 190 feet. Everywhere the character of the salt is the same, and the mine is evidently destined to supply the market for generations to come. At present the owners of the property have leased the mining privilege for a consideration to the American Salt Company.

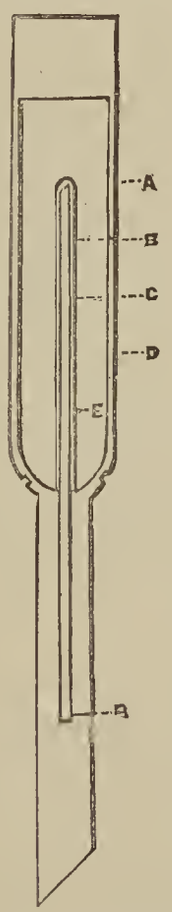
[Specimens of sandstone, lignite, and salt were exhibited, the latter in transparent cleavage crystals, some of which measured 4×3×2 inches.]

Dr. Bolton expressed his obligations to Capt. Hascall for hospitality, and to the Messrs. Avery for courtesies during his visit. He also desired to thank Mr. McCalla for kind attentions and valued information.

A NEW EXTRACTION APPARATUS.

By C. M. KING.

THE apparatus about to be described has been devised to overcome certain defects of the otherwise excellent "Soxhlet" tube in general use: these are (1) spasmodic



action of the syphon and (2) consequent flow of the extracting liquid in channels; (3) its somewhat complex form, and therefore high price. The annexed figure represents a

section of the apparatus drawn to scale. A is a wide test-tube; B, a quill tube sealed into the bottom of A, its upper end being cut off at an angle as shown; C is a tube of somewhat greater diameter inverted over B, resting on its apex and reaching nearly to the bottom of A. The outer tube, D, is so constructed below that A rests upon the projections shown; the narrow portion below passes through the cork of the flask containing the extracting liquid; the upper end is fitted with a cork through which passes an upright condensing tube with or without water-jacket, according to circumstances.

The substance to be exhausted is placed in the space between A and C, resting on a plug of glass-wool below. It is advisable to tie the plug to C at E, and thus form a support for the substance and a clear liquid space below. The liquid being brought to the boil, rises for the most part in the space between A and D, is condensed above, and flows upon the substance. the level rising in A and simultaneously in the space between B and C, until the apex of B is reached. It then flows down this quill tube, and through the intervention of C the whole of the liquid is syphoned from A into the boiling flask beneath.

This syphon is the essential point of the apparatus. Its action is characterised by automatic regularity.*

Laboratory of Messrs. Cross and Bevan,
4, New Court, W.C.

NOTE ON THE SOLUBITY OF CALCIUM COMPOUNDS.

By ALFRED H. ALLEN.

In their paper on "The Influence of Temperature on the Composition and Solubility of Hydrated Calcium Sulphate and of Calcium Hydroxide," recently read before the Chemical Society, and published in the June number of the *Chem. Soc. Journ.* (vol. liii., p. 544), Messrs. Shenstone and Cundall express some surprise that the solubility should be less in hot water than in cold.

I believe it has not been previously pointed out—or if it has the fact receives no recognition in the article on "Calcium" in the new edition of Watts's "Dictionary of Chemistry"—that this peculiar property of diminished solubility with increase of temperature is possessed by many calcium compounds. Thus it is not only true of the sulphate and hydroxide, but also of the acetate, propionate, normal butyrate, normal valerate, iso-octate, citrate, and benzoate. I do not pretend that this is anything like a complete list of the recorded cases of the kind. The instances I quote are simply those of which I happen to have readily accessible notes; but they are sufficiently numerous to suggest that the character of diminished solubility with rise of temperature has a connection with the basic radical present, as well as with the decomposition of unstable hydrates. But now that the question has been raised it might be interesting to inquire whether there is a loss of water of hydration in the instances quoted.

Sheffield, June 9, 1888.

THE KJELDAHL PROCESS FOR THE DETERMINATION OF NITROGEN.

By E. WALLER and H. C. BOWEN.

This process was devised by Kjeldahl, of Copenhagen, for use in connection with the brewing industry. The details were first published in 1883.†

A convenient amount of the nitrogenous material (0·5 to 1 grm.) was heated in a flask with 10 c.c. concentrated sulphuric acid with addition of Nordhausen acid, or phosphoric anhydride, until the solution was nearly colourless. Pulverised potassium permanganate was then cautiously added (to complete the destruction of the organic matter), until the green colour of manganic acid appeared. After cooling and diluting an excess of caustic soda solution was added, and on distilling the nitrogen (now in the form of ammonia) was titrated in the distillate. The acid was caused to act upon the material at a temperature just short of boiling. To prevent the otherwise inevitable bumping on distilling with the soda, a few pieces of metallic zinc were added to the retort or distilling flask.

Kjeldahl found that the process, as described, failed to give all of the nitrogen as ammonia in some compounds of the fatty and aromatic series, in some alkaloids, and in nitrates, though as regards the latter, when sugar was added, a much larger proportion (60 to 80 per cent) of the nitrogen than was expected was found to be converted into ammonia.

The theory of the process is given by Dafert as follows:—

1. The acid withdraws from the material the elements of water.
2. The action of the acid upon the organic substance also affords SO_2, which acts reducing upon the nitrogenous material.
3. Where some nitrogenous compounds partially resist this action the permanganate added toward the close of the acid treatment breaks them up, forming ammonia.

Treatment with Acid.

The relative proportions of concentrated sulphuric acid, Nordhausen, and phosphoric anhydride are not specified in the original paper. The proportion of Nordhausen acid used by different experimenters is from 20 to 50 per cent. Some, as Pflüger and Bohland, Kulisch, &c., use no phosphoric anhydride. Wilfarth also regards it as unnecessary when metallic oxides are used. It is noted by Kreusler and others that Nordhausen acid frequently contains nitric acid, which may consequently give untrustworthy results.

The proportion of phosphoric anhydride used is from 10 to 25 per cent. Some (as Kreusler) use phosphoric anhydride and omit the use of Nordhausen altogether, in some cases, however, using in its stead the metallic oxides recommended by Wilfarth. Wilfarth's modification consists in the addition of about 0·1 to 0·6 grm. CuO, and 0·7 grm. HgO.

This recommendation has been further modified by the suggestion to use the anhydrous sulphates of those metals, or even metallic mercury in place of the oxide. HgO, prepared by heating the nitrate, is inadmissible in any case.

Kulisch, in experimenting on wines, found the addition of CuO to afford but little advantage in point of speed, which was one of the main points claimed by Wilfarth.

Schmitz applied Wilfarth's method successfully in the analysis of coal and coke.

Ulsch found that the operation was hastened by the addition of 5 drops of a $PtCl_4$ solution containing 0·004 grm. metallic Pt per c.c. Platinum black was unsatisfactory. Adding also 0·05 grm. CuO gave still better results. He found, however, that an excess of platinic chloride might easily cause loss of nitrogen.

Adding the acid by instalments was found to be of advantage in certain researches of C. Arnold, and of Brunemann and Seyfert. About one-fourth of the whole amount of acid was first added, and the flask gently heated until frothing had materially diminished, when the remaining three-fourths were added, and the operation conducted as usual.

It is asserted by Lenz that the size of the flask in which the operation is conducted has a material influehce upon the amount of acid and of time required for effecting the

* The apparatus can be obtained of Messrs. E. Cetti, of Brook St., Holborn.

† Fresenius, *Zeit. Anal. Chem.*, xxii., 366.

decomposition. This may be the cause of the wide disagreement of different experimenters on those points.

To avoid loss by spattering, some use long slender-necked flasks, while many others use some perforated bulb stopper arrangement in the neck of the flask. Slanting the flask also is another device. Special forms of heaters, protecting the flasks by wire gauze, or using the naked flame, &c., are details which have been differently managed by different analysts.

Use of Permanganate.

Czeczetka proposes the use of a solution of the permanganate in concentrated sulphuric acid, instead of the pulverised form. Lenz, Kulisch, and some others regard the use of this reagent as a very necessary part of the operation, but C. Arnold, as well as several others, omit it as useless. With these latter, Asboth agrees only partly, stating that it is necessay in the case of difficultly decomposable substances, as morphine, &c. On the other hand, Wilfarth and some others regard its use as involving possible loss of ammonia. Many of the chemists referred to quote analyses in support of their views on this point.

Distillation.

Bumping is prevented by passing a current of steam through the solution, by Petri and Lehmann.

Asboth adds enough Rochelle salt to prevent any precipitation of metallic hydrates by the alkali. Wilfarth found that bumping occurred when soda was used, but not with potash. Scovell's experience is exactly the reverse. It is noted by many experimenters that the evolution of hydrogen when metallic zinc is added causes some of the alkali to be carried into the distillate, and to obviate this, some advise interposing wire gauze, or glass beads, &c., in the neck of the distilling flask, while others use a bulbed tube above the flask. Much of the caustic soda and potash sold for laboratory use has been purified by fusion with nitrate, and in contact with zinc this may afford enough ammonia to interfere with the correctness of the results.

When mercury or its compounds have been used in the treatment with acid (Wilfarth's process), potassium, or sodium sulphide must be added, to break up the mercur-ammonium compounds. Ulsch uses ferrous sulphate for that purpose.

Presence of Nitrates.

To *remove* nitrates when present, Warington first heats the material with ferrous sulphate and hydrochloric acid, and, after drying, proceeds as usual. Reitmair accomplishes this by heating the substance with sulphuric acid in a tin capsule, finally throwing capsule and contents into the decomposition flask. The French Association of Sugar Chemists remove the nitrates by heating for some time at 110° C. in contact with oxalic acid.

To *determine* the nitrogen in nitrates by this method, Asboth proposes the addition of about 1·7 grms. benzoic acid to every 0·5 of nitrate. Spencer and C. Arnold, however, did not obtain satisfactory results by this means, though the latter found it fairly good when larger amounts of benzoic acid were used. Jodblauer proposed the use of phenol-sulphuric acid, followed by zinc dust, the theory being that nitrophenol is at first formed, which, by the action of the zinc, is converted to an amide, and by the subsequent treatment into ammonia. Stutzer and Reitmair only find this method effective after treating the material with water and evaporating to dryness in order to distribute the nitrate through the mass in a finely-divided condition. Salicylic acid, instead of phenol, has been found by Scovell to be more advantageous. He prescribes for 0·7 to 1·4 grms. of the substance, 30 c.c. sulphuric acid, and 2 grms. of salicylic acid, followed by the gradual addition of 8 grms. of Zn dust, and then 2 or 3 drops of platinic chloride. After gentle heating until frothing ceases, and then more strongly for five or ten minutes, 0·7 grm. HgO is added, and the heating continued as usual.

General.

The process commends itself in the examination of many nitrogenous substances, on the score of expense of material and of trouble; in the matter of economy of time the statements are very diverse. It seems hardly safe, as yet, to claim for the process universal applicability. It has been noted, especially with azo- and diazo-compounds, that the treatment permits of some loss of nitrogen in the elemental state, and with some others, as those of the pyridin and chinolin group, the process seems to fail.

In using this process upon fertilisers, flour, cattle foods, and material of that nature, we have found that many of the devices recommended by other experimenters can be made unnecessary. A method found to be satisfactory is as follows:—

The substance to be examined is first tested as regards its action with concentrated sulphuric acid. Then 0·5 to 1·5 grms. of the material is weighed out in a flask of 100 to 150 c.c. capacity: the flask should have preferably a short wide neck (nearly 1 inch diameter). Enough concentrated sulphuric acid usually 5 to 12 c.c.) is then added, to maintain a liquid state of the mixture on heating. If too little acid is used a coke-like mass results, which is difficult to manage. After adding the acid, a short funnel with wide stem may be inserted in the neck. Such funnels may be easily made from glass tubing of about $\frac{3}{8}$ths inch internal calibre. The heat is applied gently until foaming ceases, when it is gradually increased. The heating is performed on a tin plate, with or without a bit of sheet asbestos under the flask. When the condition of the contents of the flask will permit it (which is usually very soon after frothing has ceased), a clay chimney is placed about the flask, to protect it from the cooling influence of the external air. *The mouth of the flask and funnel must be below the top of the protecting chimney or guard.* It may even be well to lay a clock glass across the top of the guard, leaving of course some exit for the fumes. The flame of a good Bunsen burner may be applied, to the extent of heating the supporting plate to a cherry-red. Thus arranged, the oxidation and simultaneous evaporation of the sulphuric acid proceeds very rapidly. The heating is kept up until the contents of the flask are reduced to about 2 c.c. Under the conditions described this will take about an hour. Ordinarily the solution is then quite colourless; at times it has a pale reddish tint, and sometimes, though rarely, the reddish tint is deeper. In the latter case 2 to 3 c.c. of Nordhausen acid are added, and it is heated as before.

After obtaining a solution which is nearly or quite colourless, the contents of the flask are allowed to cool before adding the permanganate (in powder). After adding this reagent, gentle warming will cause it to exert its effect. Now evaporate down to about 1·5 c.c., cool, dilute with water to about 150 c.c., and transfer to an Erlenmeyer flask of about 250 c.c. capacity, having a doubly perforated stopper. Through one hole passes a bulbed exit tube leading to the condenser, through the other a stopcock funnel tube, the end of which reaches nearly to the bottom of the flask. Through the latter a solution of caustic soda or potash is introduced, in sufficient quantity to give a decided precipitate of manganous hydrate. The distillation can then be effected without difficulty. The end of the condenser is allowed to dip into water containing a known amount of standard acid, which is titrated back as usual, after distilling off about one-half of the contents of the flask.

The principal advantages of this mode of management consist in a marked saving of time and increased effectiveness of the sulphuric acid, thus dispensing for ordinary work with any addition of phosphoric anhydride, metallic oxides, &c. Moreover, by driving off much of the excess of acid, and exercising reasonable care in the neutralisation of the remainder, the distillation can be effected without danger from the bumping of the solution.

We have not investigated as to how far it may be

possible to omit altogether the use of the permanganate, though it seems probable that in many cases it might be dispensed with.

In the Table below are some of the results obtained, as compared with the Ruffle and absolute methods. The results on sodic nitrate and fertilisers containing nitrate are only given as confirmatory of the failure of the method to give trustworthy results without modification. With pure nitrate a considerable quantity of sugar was used. The Ruffle method also fails in presence of nitrates.

	Kjeldahl.	Ruffle.	Absolute.	Theory.
Urea	46·662	—	—	46·754
,, ...	46·620	—	—	46·754
,, ...	46·816	—	—	46·754
,, ...	46·704	—	—	46·754
Impure ammonia sulphate	20·42	20·70	—	21·21
Sodic nitrate	4·49	11·64	16·6	16·47
Cotton-seed meal	6·20	6·30	6·37	—
,, hulls	0·448	—	—	—
Fertiliser	2·72	2·42	2·74	—
,, ...	2·26	2·33	2·25	—
,, containing nitrate	1·18	2·00	2·40	—
,, ,,	1·93	2·36	2·44	—
,, ,,	3·44	4·06	4·51	—

It may also be added that the students in the Quantitative Laboratory of the School of Mines have repeatedly obtained, by the Kjeldahl process, results on fertilisers which agree closely with those obtained by the more elaborate combustion processes.

We append references to the literature on the process, arranged alphabetically as to authors' names:—

Arnold.—Arch. Pharm. (3rd ser.), xxiii., 177; xxiv., 785. Chem. Centralblatt, 3rd ser., xvii., 337. Zeite. f. Anal. Chem., xxv., 454. Rep. anal. Chem., iv., 97.
Armsby.—Amer. Chem. J., viii., 323.
Von Asboth.—Chem. Centralblatt, 3rd ser., xvii., 161.
Balcke.—Wochenschrift f. Brauerei, i., No. 11.
Bohland.—Arch. f. gessammt. Physiol., xxxv., 454; xxxvi., 102; and xxxvii., 423.
Bosshard.—Zeitschr. f. Physiol. Chem., ix., 63. Zeits. f. Anal. Chem., xxiv., 199.
Brunemann.—Chem. Ztg., viii., 1820.
Czeczetka.—Monatshefte f. Chem., vi., 63.
Dafert.—Sitzungsber. Niedershein. Gesell., 1884, 203. Landwirths. Versuchs Stat., xxxiv., 311.
Farrington.—U.S. Dept. Agric. Bulletin, No. 16.
Hannin.—Zeits. f. Anal. Chem., xxv., 155.
Heffter.—Chem. Ztg., viii., 432.
Hollrung.—Chem. Ztg., viii., 432.
Jodblauer.—Chem. Centralblatt (3rd ser.), xvii., 433.
Kjeldahl.—Zeits. f. Anal. Chem., xxii., 366.
Kreusler.—Zeits. f. Anal. Chem., xxiv., 393. Landwirths. Versuchs. Stat., xxxi., 209.
Kulisch.—Zeits. f. Anal. Chem., xxv., 149.
Lehmann.—Zeits. f. Anal. Chem., xxiv., 388. Zeits. Physiol. Chem., viii., 200.
Lenz.—Zeits. f. Anal. Chem., xxvi., 590.
Märcker.—Zeit. f. Spiritus Ind., viii., 223. Wochenschr. f. Brau., 1886, 190.
Morgen.—Chem. Ztg., viii., 432.
Neal.—Report of N.J. Agric. Exper. Station, 1886.
Petri.—Zeits. f. Physiol. Chem., viii., 200.
Pfeiffer.— Zeits. f. Anal. Chem., xxiv., 388.
Pflüger.—Arch. f. gesammt. Physiol., xxxvi., 102.
Reitmair.—Repert. Anal. Chnm., v., 232 and 262; vii., 4.
Rindall. –Zeits. f. Anal. Chem., xxv., 155.
Reinke.— Wochenschr. f. Brau., 1885, 191.
Rube.—Zeits. f. Anal. Chem., xxiii., 43.
Ross.—Chem. News, lv., 151.
Schmitz.—Zeits. f. Anal. Chem., xxv., 314.
Scovell.—U.S. Dept. Agric. Bulletin, No. 16,
Seyfert.—Chem. Ztg., viii., 1820.
Short.—Amer. Chem. J., viii., 323.
Spencer.—Chem. News, lv., 20.
Stebbins.—Jour. Am. Chem. Soc., vii., 108.
Stutzer.—Repert. Anal. Chem., v., 232, and vii., 4.
Ulsch.—Chem. Centr. (3), xviii., 284. Zeits. gesammt. Brau., 1886, 81; 1887, 3.
Warington.—Chem. News, lii., 162.
Wilfarth.—Chem. Centralbl. (3rd ser.), xvi., 17 and 113.
Wilkinson.—Chem. News, lv., 151.
Yardley.—Chem. News, lii., 220.

Abstracts of many of these papers may be found in—

Journal of Lond. Chem. Soc., xlvi., 364; xlviii., 430, 688, 837, 930, 1261; l., 179, 282, 648, 652, 834, 1071; lii, 78, 298, 863.
Chem. News, xlviii., 101; l., 58; li., 285; lii., 107; lv., 249; lvii., 64.
Zeits. f. Anal. Chem., xxiii., 596; xxiv., 299, 453, 635; xxv., 252, 280, 426, 575; xxvi., 92, 249, 646; xxvii., 73.

PROCEEDINGS OF SOCIETIES.

THE ROYAL SOCIETY.

The following is a list of the principal exhibits at the Ladies' Conversazione on June 6th, 1888:—

Experiments with Soap-bubbles.—Exhibited by Mr. C. V. Boys, A.R.S.M.

These experiments are arranged to show chiefly the power of an air film to prevent two bubbles from coming into real contact. Thus, among other experiments, the outer of two bubbles may be pulled out until it squeezes the inner one into a long oval, but no real contact takes place. If either of these bubbles is coloured with uranine it will, when properly illuminated, appear a brilliant green, while the other one remains clear, showing that they do not really touch, or if the outer one is broken the inner one floats away. An inner bubble filled with gas will carry up an outer one to which are attached a wire ring and other things without really touching it at all.

The rapid diffusion of ether vapour through a soap film is shown in several ways. Thus a bubble which has been floating on ether vapour for a few seconds becomes so heavy that, when lifted into the air, it hangs like a heavy drop; further the vapour, as it oozes through the film, is seen on the screen to fall away in a heavy stream, while the gas which issues from the supporting pipe burns with a large and steady flame, showing still more conclusively that the inflammable vapour has penetrated through the film.

Two bubbles resting against one another instantly coalesce when the most feebly electrified body is brought near, but one bubble resting inside another is completely protected from comparatively powerful electrical influences by the outer one, and so the bubbles remain separate.

Gradational Colour Blender. — Exhibited by Sir Frederick Bramwell, D.C.L., F.R.S.

A cylinder, clothed with different colours varying from end to end of the cylinder, so that, on being revolved, the effect of the blending of the colours in varying proportions is exhibited, and thus the value of these proportions can be compared.

Large Electrical Influence Machine.—Exhibited by Mr. James Wimshurst.

It has 12 disks, each 2 feet 6 inches in diameter, and carrying 16 metal sectors. Will obtain full excitement with less than one revolution of the handle in any condition of the atmosphere. The length of spark is 13½ inches.

New form of Hydrometer for testing the strength of Acids in Electric Batteries and other Apparatus.—Exhibited by Mr. James J. Hicks.

Sir William Thomson's Models of Foam or Froth consisting of Equal Bubbles.—Exhibited by Prof. G. H. DARWIN, F.R.S.

Each bubble is a curvilinear 14-faced space. If a single bubble be dissected from the mass, it is found to be derived from the regular octahedron (two square pyramids base to base) by truncating the six solid angles. Thus the eight faces of the octahedron give rise to eight curvilinear hexagons, and the six solid angles to six curvilinear squares.

In the foam three films meet at 120° at each edge, and of the three which meet two are hexagons and one is a square.—*See Phil. Mag.*, vol. xxiv. (1887), p. 503.

Selecting Microtome at work, illustrating a new Method, by which Series of Sections of Microscopic Objects may be made from fresh or fixed Tissues.—Invented and exhibited by Mr. W. H. CALDWELL, M.A., Fellow of Gonville and Caius College, Cambridge.

(1.) The Selecting Microtome.

The sections are delivered automatically on to glass slides, and either a complete and continuous series, or any required fraction of such (*e.g.*, every $\frac{1}{10}$ section), is received mounted with each section touching its predecessor on the slide.

Series can be made from either frozen or dry objects.

The sections flatten by "surface tension" as they are cut, and being always supported can be cut considerably thinner than by the older methods.

With the best steel razor $\frac{1}{20000}$ inch = 0·5μ can be reached.

(2.) *Apparatus for Accurately Imbedding Objects in Celloidin or in Insoluble Gelatin.*—Invented and exhibited by Mr. W. H. CALDWELL, M.A., Fellow of Gonville and Caius College, Cambridge.

(*a.*) Celloidin—

If an alcohol-ether solution of celloidin be poured on the surface of chloroform a jelly of celloidin equal in volume to the original solution rapidly forms.

This is due to the great density of the chloroform preventing any mechanical disruption of insoluble celloidin, while the ether and alcohol readily dissolve in the chloroform.

The apparatus is designed to control this action of chloroform.

(*b.*) Gelatin.

New uses of the Magnifying Spring.—Exhibited by Profs. W. E. AYRTON, F.R.S., and JOHN PERRY, F.R.S.

The end of an ordinary spiral spring made of round wire, such as is used in a spring balance, does not appreciably rotate when the spring is stretched. But by making the metal flat, and winding it up like a thin shaving, a spring is produced, the end of which turns through a large angle for a small axial extension of the spring, the ratio of rotation to axial extension being the greater the smaller the diameter of the spring.

Specimens of the magnifying springs of various sensibilities are exhibited, and they are also shown, applied to—

(1.) Simple apparatus for measuring the coefficient of expansion by heat.
(2.) Vacuum and pressure gauge.
(3.) Micrometer indicating the one twenty-thousandth of an inch.
(4.) Thermometer.
(5.) Portable voltmeter for measuring alternating potential differences, and a large working model showing the principle.

Modified Maxwell Galvanometer with Invariable Sensibility.—Exhibited by Profs. W. E. AYRTON, F.R.S., and JOHN PERRY, F.R.S.

The ordinary torsional suspension is dispensed with, and the controlling couple is produced by the action of the magnetic field on a number of small magnets rigidly attached to the moving coil. Hence, not merely does the deflecting couple for a given current vary with the strength of the magnetic field, but so also does the controlling couple, consequently the deflection for a given current is practically unaffected for wide variations in the strength of the field.

The object of attaching many small magnets to the moving coil is to cause the controlling couple to vary directly with the deflecting couple, even when the strengths of different portions of the field occupied by the coil are varied in very different proportions, a result which is found to occur when one of the stationary magnets alters its magnetism much more than the rest of the magnets forming the compound permanent magnet, or when the field is much distorted by the presence of some large neighbouring magnet.

(1.) *Experiments Illustrating Low-temperature Spectra, in Connection with the Spectra of Meteorites.*—Exhibited by Mr. J. NORMAN LOCKYER, F.R.S.

Spectra of carbon, magnesium, manganese, lead, iron, and barium, at the temperature of the oxy-coal-gas blowpipe.

The celestial bodies, the spectra of which give indications of the lines, bands, and flutings, seen under these conditions, are in all probability at a low temperature.

According to the meteoritic hypothesis, every body in the universe, at the beginning of its history as a self-luminous one, was composed of a sparse swarm of meteorites, and was then in the condition of what we call a nebula. The spectrum of a nebula consists mainly of lines of hydrogen, and the low temperature lines and fluting of magnesium, the latter of which is well seen at the temperature of the Bunsen burner or oxy-coal-gas flame, but is invisible at a higher temperature.

By the subsequent condensation, due to gravity, the temperature of the swarm composing the nebula would be increased, and the result would be one of the so-called "stars" with a bright line spectrum, in which there are flutings of carbon and the lines of iron, sodium, and manganese seen in the oxy-coal-gas flame. Nebulæ and "stars" with bright line spectra are classed together as bodies of group 1.

Further condensation would result in the appearance of absorption bands, owing to the diminution of the interspaces, and we would then have a body of the 2nd group. The dark bands seen in the spectra of these bodies are due to magnesium, manganese, lead, barium, and iron, and there are also the bright flutings of carbon.

(2.) *New Chart of the Pleiades.* Prepared by the Brothers Henry, from photographs taken at Paris, on November 16th, and December 14th, 1887.—Exhibited by Mr. J. NORMAN LOCKYER, F.R.S.

The time of exposure was four hours in each case. These photographs show a much greater area of nebulosity than those taken in 1885, in consequence of the more perfect methods employed.

It will be observed that there are several apparent lines of nebulosity, one of which passes through no less than seven stars. This strengthens the view that stars are sometimes formed by the intersection of two meteor swarms.

In connection with the chart, a map of the spectra of the principal stars in the Pleiades, prepared from the photograph taken by Prof. Pickering for the Henry Draper Memorial, is also exhibited. All the spectra are of the 4th group, and they are arranged on the map in order of temperatures.

Exhibited by WILLIAM CROOKES, F.R.S.:—

Specimens of Auriferous Quartz, Auriferous Blende, and other gold-bearing minerals from Mr. Pritchard-Morgan's mine, Gwynfynnydd, near Dolgelly, North Wales. Ingot of gold from the above mine:—Weight 2128 ounces, or 1 cwt. 33lbs. Value £8400.

Exhibited by Prof. W. C. ROBERTS-AUSTEN, F.R.S.:—

Specimens illustrating an attempt to revive a branch of Art Metal-work now neglected in Japan. The best native examples were made in Nagoya by retainers of the Daimio of Owari.

Thin sheets of metals and alloys are soldered layer upon layer, care being taken that metals which will present diversity of colour come together; holes of varied shapes and depths are then drilled in the mass, or its surface is covered with devices in trench-like cuts of V section, and the metal is hammered until the holes or trenches disappear, being replaced by banded circles or lines. The colours of the layers may then be developed by suitable "pickling solutions."

Descriptive labels accompany the specimens, which include two native examples of "Mokumè" or wood-grain alloy, prepared by the method described above.

Exhibited by Prof. J. W. JUDD, F.R.S., *on behalf of the Normal School of Science, and Royal School of Mines, South Kensington:—*

Specimens of Quartz-Crystals, illustrating their internal structure.

(1). Crystal of smoky quartz, with naturally etched faces, showing that it is formed by the complicated intergrowth of two individuals with opposite polarity. (Both of these individuals exhibit left-handed circular polarisation).

(2). Sections cut at right angles to the principal axis of the crystal, and artificially etched with hydrofluoric acid. The sections illustrate the complicated intergrowth of the two individuals and the presence of lamellæ with different etching figures in certain parts of the crystals.

(N.B.—The lamellæ are shown, by their behaviour under convergent polarised light, to consist of alterations of right and left-handed quartz. Their relation to cracks in the crystal shows them to be of *secondary* origin).

(3). Prism-plane of same quartz-crystal, showing that these lamellæ are developed parallel to the rhombohedral planes of the crystal.

(4). Other quartz-crystals exhibiting a lamellar structure, which has been developed by etching with hydrofluoric acid.

NOTICES OF BOOKS.

A Manual of Practical Assaying. By JOHN MITCHELL F.C.S. Edited by WILLIAM CROOKES, F.R.S., Pres.C.S. Sixth Edition, Illustrated with 201 Woodcuts. London: Longmans, Green, and Co.

WHEN a scientific or technical work is fully known among specialists, and when the recurring demand for new editions proves that it is appreciated, there can be no need either for an exposition of its scope and character, or for any attack upon or defence of its leading features.

The duties of the editor have been by no means unimportant. Whilst the main characters of the work have been preserved, it has been found necessary to omit much matter which has been superseded, to re-write other portions, and to make additions extending to no fewer than 90 pages.

Among the most important additions which have been found necessary we may mention the account of Mr. D. W. Brunton's automatic sampling machine, a device which saves no inconsiderable expenditure of time and trouble.

The gas- and petroleum-spirit furnaces invented or improved by Mr. Fletcher, Messrs. Griffin, and others are duly described and figured. There is further an account of new reagents and new processes, gravimetric, volumetric, and colorimetric, especially for the assay of iron ores, iron, steel, spiegeleisen, &c. The spectroscope has not, so far, proved itself an available instrument in assaying. Its application to the assay of gold and silver alloys has been attempted by two most skilful chemists, Professor Chandler Roberts-Austen, F.R.S., Chemist to the Mint, and Mr. A. E. Outerbridge, Assistant in the Assay Department of the United States Mint, but the results obtained have been far from satisfactory. It has not been found possible to obtain alloys of gold so absolutely homogeneous that the minute quantity of metal actually volatilised, and yielding the spectrum may be a true representation of the whole ingot. We find no electrolytic methods save those for the assays of copper and of mercury.

Not the least important addition to the work is the full description of the American dry copper assay. The editor disapproves of the Cornish assay, but fears that it will not be superseded for some time, owing to the manner in which it is mixed up with trade usages.

The deteriorating action of bismuth, even in small quantities, upon the ductility of silver is pointed out, and appropriate methods are given for its recognition. The section on gold has also also been improved and extended, especially as regards its detection in poor ores.

The present edition is in every respect an improvement on its predecessors, and should prove highly welcome to assayers, metallurgists, and mining engineers.

Skeleton Notes upon Inorganic Chemistry. Part. I.—Non-Metallic Elements. By P. DE P. RICKETTS, Ph.D., Professor of Assaying in the School of Mines, Columbia College, N.Y. City, and S. H. RUSSELL, E.M. New York: John Wiley and Sons. 1887.

So far as the writer knows this is a decidedly original work, being intended to aid the student of elementary chemistry in taking notes in the class-room.

The book includes Tables of Atomic Weights and Specific Gravity, the Non-Metallic Elements, arranged alphabetically and indexed, with blank pages of fine writing-paper between. The principal facts and constants of each element are briefly printed on the upper pages (the book opens lengthwise and from the reader), leaving the nearer pages for additional notes and such explanations as the lecturer may utter. A number of blank pages at the beginning and end of the book provide for general notes and memoranda.

These "Skeleton Notes" are not intended to take the place of a text-book; on the contrary, the authors encourage the use of one, and say that much matter has been purposely omitted for the student to supply by filling out the blank pages. The authors believe that the student, by having before him, in a condensed form, the leading points in regard to each chemical element and its compounds, will learn to work in a systematic way in following lectures, and in the study of text-books.

The arrangement of the compounds is such as to present very clearly the manner in which they are formed. In the comparison of members of the same group—as bromine, chlorine, iodine, and fluorine—the "skeletons" show at a glance the relations which exist between these elements and their compounds.

As a handbook for the lecture-room, study, or laboratory, the information wanted will be found in a concise form, and more quickly than by reference to the ordinary text-books.

The authorities consulted, and from which the Notes have been compiled, are Watts's "Manual of Chemistry" and Roscoe's "Elementary Chemistry," and great pains have been taken to insure accuracy and to state only what is known and most important.

The heads under each element are commonly:—Name, history, occurrence, preparation, properties, detection, applications, compounds; distinctive type makes it easy to comprehend the arrangement of material.

The book promises to be a useful addition to the tools of students of elementary chemistry. The name of Prof. Ricketts, well known by his "Notes on Assaying and Assay Schemes," is a guarantee of accurate work. A good feature is that the book does not contain too much; thus we note the entire absence of equations, the student being left to his own resources in this and other particulars.

We notice that under Boron and Tellurium the sections on name and history are omitted,—probably an oversight. The derivation of Selenium is also wanting. We object to the terms iodides of potash and of soda. These slight blemishes, easily corrected in the plates, do not detract from the value of this useful manual and note-book combined.

CORRESPONDENCE.

CONSTITUTION OF ANTIMONIUM-POTASSIUM OXALATE.

To the Editor of the Chemical News.

SIR,—I should be glad if you would allow me to point out an error in Mr. Percy Kay's paper "On the Analysis and Composition of Antimonium Potassium Oxalate." which appeared in the CHEMICAL NEWS, vol. lvii., p. 193. The constitutional formula ascribed to the double oxalate, $K_4Sb_2(C_2O_4)_6$, is incorrect, since the carboxyl groups of the oxalic acid are represented as C—O—OH, and not

$$\begin{matrix} C=O \\ | \\ -OH \end{matrix}$$

as they should be.

Since I shall no doubt be held responsible for the contents of this paper, emanating as it does from this College, I may be allowed to state that it was published during my absence and without my consent. I have waited until now to see whether anyone else might draw your attention to the error, but as this has not been the case, I take this opportunity of doing so myself.—I am, &c.,

EDMUND KNECHT.

Bradford Technical College,
June 2, 1888.

THE ACIDITY OF CARBONIC ACID.

To the Editor of the Chemical News.

SIR,—Your correspondent, Mr. Farrington, will no doubt pardon me if I point out that his observation as to the decolouration of an alkaline solution of phenol-phthalein by carbonic acid (CHEM. NEWS, vol. lvii., p. 214) has been already published. The whole subject has been almost exhaustively treated in a paper by myself and my son, C. Napier Draper, which appeared in the CHEMICAL NEWS of April 1st, 1887 (vol. lv., p. 143).

Mr. Farrington has, however, done useful service in calling attention to what is really an excellent lecture experiment. Perhaps the best way of performing this is to discharge part of the contents of a syphon of soda-water into the coloured liquid.—I am, &c.,

HARRY NAPIER DRAPER.

Dublin, June 6, 1888.

APPARATUS FOR GENERATING GASES.

To the Editor of the Chemical News.

SIR,—I notice in your issue of the 1st inst. (CHEMICAL NEWS, vol. lvii., p. 213) an apparatus for the preparation of H, CO_2, and H_2S, by Mr. Johnson, of King's College, and should like to state that I have devised a similar apparatus, which has been in use at Finsbury Technical College during the past nine months.

I have made several improvements on my original form, and those of your readers interested will find full particulars of the same in Messrs. Townson and Mercer's new Catalogue.—I am, &c.,

HENRY CONRAD CORAM.

City and Guilds of London Institute.
Technical College, Finsbury, London, E.C.,
June 12, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of emperature are Centigrade unless otherwise expressed

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 22, May 28, 1888.

Researches on Ruthenium; the Rutheniates and Hepta-rutheniates. — H. Debray and A. Joly. — Ruthenium is attacked by a melting mixture of nitre and potassa, and it forms with the alkali a compound soluble in water, in which it gives a very intense orange-red solution. This is a characteristic reaction of ruthenium. Although there is an evident analogy of composition and of reactions between potassium rutheniate and hepta-rutheniate and the corresponding manganate and permanganate, yet there is no relation of isomerism between the salts of the acids of ruthenium and those of manganese. Potassium rutheniate is hydrated, whilst the manganate is anhydrous like the sulphate.

Researches on the Application of Rotatory Power to the Study of the Compounds formed by the Action of Neutral Sodium and Potassium Tungstates upon Solutions of Tartaric Acid.—D. Gernez.—Tartaric acid forms, with neutral potassium tungstate, a compound, $C_8H_6O_{12}+2(KOWO_3)$, and which corresponds to the maximum rotation observed, which is 23 times greater than that produced by the tartaric acid present.

The Production, in the Dry Way, of Crystalline Ferric Hydrates.—G. Rousseau and J. Bernheim.—The authors have sought to crystallise sodium ferrite by heating ferric oxide with caustic soda. As this method did not succeed, they employed ferric hydroxide and obtained compounds in which basic water is substituted for the larger part of the soda in the ferrite. On using a mixture of sodium chloride and sodium carbonate in place of caustic soda they obtained a new hydrate analogous to the former. The crystalline tables derived from the calcination of a mixture of iron sulphate and sodium chloride do not correspond to oligistic iron, but are a ferric hydrate containing a little soda. The weight of the soda and the water of these hydrates, though variable in absolute amount according to the temperature of the experiment and the nature of the fluxes, are in the approximately constant proportion of 1 : 3. All attempts to substitute potassa for soda have failed.

On Rhodium Sesquisulphide. — E. Leide. — The author describes the preparation of this compound in the dry and the wet way, and the formation of double sulphides of rhodium and of the alkaline metals.

On Two Isomeric Naphtho-quinoleines.—Alphonse Combes.—The α-compound melts at 44° and distils without decomposition about 360° to 362°. The β-compound melts at 66° to 67° and distils at 380°, but takes a strong red colour unless distilled at a vacuum.

On Oil of Cajeput.—R. Voiry.—On fractional distillation this oil yields a terpilenol, which has no action upon polarised light. There were further obtained acetic, butyric, and valerianic ethers mixed with a carbide boiling at 160° in a vacuum.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. Series 5, Vol. iii., No. 26.

Report by M. Bérard, on behalf of the Committee of Chemical Arts, on the Cryptographic Processes of M. Schlumberger.—The author merely states that M. Schlumberger introduces into the paper pulp substances which become coloured under the influence of certain reagents. The process has been successfully adopted by two railway companies.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 6.

Gravimetrical Determination of Total Solids and Fat in Milk and Butter by Means of Woody Fibre.—F. Gantter.— The author, instead of the paper proposed by Dr. M. A. Adams, uses for absorbing the milk "wood-stuff," as obtained by the sulphite process for the paper-manufacture. It requires merely to be dried and extracted with petroleum ether in order to remove all traces of resinous matter. Two grms. of wood-stuff are placed in the capsule intended for the evaporation of the milk, along with a small glass rod, dried at 105° until the weight becomes constant, and weighed along with the capsule. During weighing the capsule should be closed with a well-fitting cover. Of the sample of milk, which has been previously placed in a small phial, weighed, and stoppered, 5 to 6 grms. are poured as evenly as possible upon the wood-stuff in the capsule, and the exact quantity taken is ascertained by re-weighing the phial. The capsule is then placed upon the water-bath, and care is taken, by stirring and pressure, that the wood-stuff sucks up all the milk, leaving the sides of the capsule scarcely moist. During the evaporation the whole is stirred occasionally, so that no particles of the wood are left adhering to the metal. If at the beginning of the process small quantities of milk not absorbed are seen on the sides and the bottom, they are pressed and rubbed with the wood by means of the glass rod until the spot appears perfectly clean and bright. In an hour the contents of the capsule are dried up so far that the operation may be completed in the drying closet, which takes an hour and a half longer. The total solid matter is shown by the increased weight of the capsule. The dry matter thus obtained is enclosed in paper in the ordinary manner and placed in Soxhlet's apparatus.

Determination of Tannin.—F. Gantter.—The author has examined the proposed method of precipitating tannin, not with hide-powder, but with ferric acetate. In 10 c.c. of the solution of tannin the total proportion of tannin + non-tannin is determined. Then, on the one hand, 50 c.c. of the tannin solution were precipitated with hide and 10 c.c. were again titrated after the completion of the precipitation. On the other hand 50 c.c. of the same solution were precipitated with 10 c.c. ferric acetate (decinormal) made up to 100 c.c. and then 20 c.c. = 10 c.c. of the original solution was titrated. The results showed that with many tanning materials higher values were obtained by the hide process than the ferric acetate process.

Volume and Proportion of Carbon in the Gases Evolved on Dissolving Iron in Acids. — Helge Bäckström and Gunnar Paijkull.—This paper requires the accompanying illustrations.

Remarks on Dr. Anton Baumann's Paper on the Determination of Ammonia in Arable Soils (*Zeitschrift Anal. Chemie*, vol. xxvi., p. 302).—W. Knop.—The author cannot admit that Dr. Baumann has contributed to the solution of the question of the determination of ammonia in soils.

MEETINGS FOR THE WEEK.

WEDNESDAY, 20th.—Geological, 8.
—— Meteorological, 7.
THURSDAY, 21st.—Royal, 4.30.
—— Chemical, 8. Ballot for the Election of Fellows. "Chlorofumaric and Chloromaleic Acid, their Derivatives and Magnetic Rotatives," by Dr. W. H. Perkin, F.R.S. "Combustion by Means of Chromic Anhydride," by C. F. Cross and E. J. Bevan. "Metoxylensulphonic Acids," by Dr. G. T. Moody. "Researches on Isomeric Changes," by Dr. H. E. Armstrong. "A New Method for the Production of Mixed Tertiary Phosphines." by Dr. N. Collie.
FRIDAY, 22nd.—Quekett Club, 8.
SATURDAY, 23rd.—Physical, 3. "Note on Continuous Current Transformers," by Prof. S. P. Thompson, D.Sc.

NOTES AND QUERIES.

History of Chemistry as Known to the Ancients.—(Reply to Gertrude Amburger).—Consult Berthelot's most interesting work—"Les Origines de l'Alchimie." Also "Eleven Centuries of Chemistry," by Professor Ferguson, of Glasgow; Address to the Chemical Section of the Philosophical Society of Glasgow, November 11th, 1878.—W. N. HARTLEY.

History of Chemistry as Known to the Ancients.—(Reply to Gertrude Amburger).—The following works may assist your correspondent:—"Allgemeine Encyclopädie der Wissenschaften und Künste u. alphabetische Folge." von genanten Schriftstellern bearbeitet und herausgegeben von T. S. Ersch und T. G. Gruber, Professoren zu halle; 1 Section, 16 Theil; Leipzig, 1827; see "Chemie," pp. 247—263. Also Meyer's "Conversations Lexicon," Band vii., Abth. 2; Hildburghausen, 1845; see "Chemiatrie und Chemie," &c., pp. 79, 137. Also "Bibliotheca Chemica" (E. A. Luckold); Göttingen, 1859. "Bibliotheca Chemica et Pharmaceutica" (R. Ruprecht); Göttingen, 1872. "Quellen-Literatur der theoretisch-organischen Chemie" (E. T. Wolff); Halle, 1845. "The Catalogue of Scientific Serials, 1633—1876," by Samuel H. Scudder (Cambridge, Library of Harvard University, 1879), has all the chemical publications of Europe and America.—PATRICK O'BRIEN, Kingsland.

Alcohol in Water.—(Reply to "Delph.")—Your correspondent will find what he requires, namely, a reference to M. Müntz's estimation of alcohol in natural waters, in the Cantor Lectures, "Fermentation and Distillation," delivered before the Society of Arts, May 12th to 26th, 1884. Alcohol was detected in the Vartry water supplied to Dublin.—W. N. HARTLEY.

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London: J. and A. CHURCHILL, 11, New Burlington Street.

CIVIL SERVICE COMMISSION.—Forthcoming Examination. Assistant to the Lecturers on Chemistry, &c., at the Royal Artillery College (25—30), 3rd July.
The date specified is the latest at which applications can be received. They must be made on Forms to be obtained with particulars from the Secretary, Civil Service Commission, London, S.W.

Wanted, 80,000 Kilos. Sulphuric Acid, 117° Twaddle, successive delivery; free port of discharge, Koenigsberg (Prussia),—Address offers to X. N. 2504, care of Messrs. Haasenstein and Vogler, Advertising Agents, Cologne.

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THE CHEMICAL NEWS.

Vol. LVII. No. 1491.

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NOTE ON THE VOLUMETRIC DETERMINATION OF URIC ACID.*

By A. M. GOSSAGE, B.A., Oxon.

Dr. Haycraft has recently proposed a method for the volumetric determination of uric acid in urine (*Brit. Med. Journ.*, 1885, 2, p. 1100) which has great advantages over all former methods in that it is much quicker and easier to manage. The uric acid from 25 c.c. of urine is precipitated by silver nitrate after previous addition of sodium carbonate (to prevent reduction) and ammonia (to dissolve silver chloride, &c.); this precipitate is then collected, washed, and dissolved in nitric acid, and the amount of silver present in this solution ascertained by Volhard's method, *i.e.*, titration with ammonium sulphocyanate; from this the amount of uric acid can be calculated. "In order to test the accuracy of the process," he says, "I prepared several solutions of acid urate of sodium of known strength. To these I added various quantities of common salt, magnesium sulphate, and phosphate of soda, in order to imitate as far as possible the urinary secretion. On estimating the uric acid in these solutions, I obtained wonderfully correct results. In all cases not much more than a milligramme was lost during the process, and may be simply accounted for by the fact that no salt of uric acid is absolutely insoluble. . . . . In order further to test its accuracy, 50 c.c. of urine were divided into two equal portions; to the first 25 c.c. of a solution of acid urate of sodium of known strength were added; to the second 25 c.c. of water were added. When estimated the two fluids show a difference equal to the quantity of salt added." Results very closely corresponding to this were obtained.

These results do not agree with results obtained by Salkowski (Pflüger's "Archiv," vol. v., 1872, p. 210) and Maly (Pflüger's "Archiv," vol. vi., p. 201). Salkowski proposed a volumetric method for the determination of uric acid, very similar to that proposed by Dr. Haycraft; in this he added excess of silver nitrate and estimated the excess of silver present. He gave up this method, however, as on examining the silver precipitate obtained from urine, after complete precipitation of the phosphates by magnesia mixture, he found that it contained magnesium as well as silver, and that the proportion of magnesium to silver varied considerably in precipitates from different urines, though constant for the same urine. Haycraft considers that the presence and variation in amount of magnesium in these precipitates may be due to varying quantities of magnesium ammonium phosphate in them. This is, however, impossible, as the phosphates were precipitated by Salkowski previously, and the urine allowed to stand for twenty-four hours before filtration to ensure their complete separation. Salkowski's results were confirmed by Maly, who found that, if in the presence of salts of calcium, magnesium, potassium, and ammonium, a solution of a urate be precipitated by silver nitrate, the precipitate contains these metals as urates as well as silver urate.

As a test of the accuracy of Haycraft's method, I examined samples of various urines, both by his method and by Salkowski's method, which is universally acknowledged to be the most reliable, and the accuracy of which has been proved by experimental evidence. This method consists in taking 250 c.c. of urine, adding 50 c.c. of magnesia mixture to precipitate phosphates, and then adding to 240 c.c. of the filtrate (which are equivalent to 200 c.c. of the urine) silver nitrate to precipitate the uric acid. This precipitate of silver urate is decomposed by sulphuretted hydrogen after being suspended in water. The liquid is then acidified, filtered hot, and evaporated to small bulk, and the uric acid allowed to crystallise out. These crystals are then dried and weighed. The results obtained are given below.

The results obtained by Haycraft's method were always considerably higher than those obtained by Salkowski's. The reason of this is that Dr. Haycraft has assumed that the silver precipitate from urine consists of an urate containing only 1 atom of silver in the molecule, whereas the proportion of silver in this precipitate is always larger, and varies in amount in different precipitate. If we assume that the precipitate contains 2 atoms of silver in a molecule of urate and divide the results obtained by Haycraft's method by two, we see that in two cases they are about equal to, in the rest less than those obtained by Salkowski's method. The proportion of the results obtained by one method to those obtained by the other varies. This agrees with the results of Salkowski's researches, from which one would expect that the results obtained by Haycraft's method would not bear a constant relation to the results obtained by Salkowski's, and that the halves of the results by the former method would be lower than, in most cases, those obtained by the latter.

* A Paper read before the Royal Society, June 7th, 1888.

1 c.c. NH_4CNS = 0·00168 Uric Acid.

	Salkowski (200 c.c. urine).		Haycraft (25 c.c. urine).		
Expt.	Quantity of uric acid obtained.	Mean percentage.	No. of c.c. of NH_4CNS required.	Mean equivalent quantity of uric acid.	Percentage.
I.	0·168 gr.	0·084	(*a.*) 16·2 c.c. (*b.*) 16·3 ,,	0·027	0·108
II.	0·07 gr.	0·035	(*a.*) 11·8 c.c. (*b.*) 11·4 ,, (*c.*) 11·0 ,,	0·019	0·076
III.	(*a.*) 0·098 gr. (*b.*) 0·1045 ,,	0·051	(*a.*) 12·3 c.c. (*b.*) 12·1 ,,	0·0205	0·082
IV.	(*a.*) 0·068 gr. (*b.*) 0·073 ,,	0·035	(*a.*) 10·7 c.c. (*b.*) 11·1 ,,	0·018	0·072
V.	(*a.*) 0·154 gr. (*b.*) 0·160 ,, (*c.*) 0·165 ,,	0·08	(*a.*) 16·3 c.c. (*b.*) 16·4 ,,	0·027	0·108

ON BUMPING EBULLITION (SOUBRESAUTS).

By CHARLES TOMLINSON, F.R.S., F.C.S.

The *Journal of the Chemical Society*, June, 1888, contains among its abstracts a method contrived by A. Reissmann for preventing the bumping of vessels during distillation by means of bits of pumice, sunk, where necessary, by means of platinum wire.

We are very much in want of an *Index Rerum* to prevent the frequent repetition of old discoveries by young investigators. The Royal Society's Catalogue gives the names, but no plan has as yet been decided on for an index of subjects.

In January, 1869, I read a paper before the Royal Society "On the Action of Solid Nuclei in Liberating Vapour from Boiling Liquids." In this paper the cause of bumping is investigated, and the action of a large number of nuclei is tested. The nuclei employed were common charcoal, charcoal from box-wood and from cocoa-nut shell, coke, platinum-sponge, meerschaum, pumice, and similar porous bodies. The liquids operated on were water, spirits of wine, turpentine, and other essential oils. One of the most remarkable results was the action of nuclei in increasing the distillate, in some cases as much as 25 per cent. For this purpose a glass flask with a wide neck was filled about one-third with distilled water for example; it was boiled over a gas-burner, rapidly weighed, and replaced over the burner. After boiling twenty minutes it was weighed again. The flask was once more filled to the original quantity, and the nucleus added; it was boiled and weighed as before, the gas flame remaining unaltered all the time. Other arrangements were made in the case of inflammable liquids. One result may be given :—

Distillate from water only, 262 grains; from water with nucleus (in this case cocoanut-shell charcoal), 334 grains.

Ratio of results as 100 : 127·4.

The subject was practically illustrated before the Society of Arts on April 7th, 1869, in a paper "On the Theory of Boiling in Connection with Some Processes in the Useful Arts," and in the following month before the Pharmaceutical Society in a lecture, a report of which is contained in the Chemical News, vol. xix., p. 267.

Highgate, N., June 13, 1888.

REMARKS ON SOME STATEMENTS BY Mr. ROWLAND WILLIAMS ON THE DETERMINATION OF THE AMOUNT OF MORPHIA PRESENT IN OPIUM.

By E. F. TESCHEMACHER and J. DENHAM SMITH.

We have thought it possible that our paper under the above title might have provoked some observations from chemists interested in the subject, and had intended then to reply to such *en bloc*, and also to notice Mr. Williams's statements, where requisite, occurring in Chemical News, vol. lvii., pp. 134—135. As our paper has not elicited any such remarks we will address our attention to the statements of Mr. Williams.

This gentleman pays us the compliment of adopting our title, but without acknowledging its source. He then proceeds to tell his readers a "Story without an End" of two Persian gentlemen who came to him about two years since "with the object of ascertaining the most reliable methods of estimating morphia in opium." He speaks of having examined with his Persian pupils a large number of the most promising processes he could find on the subject, but confines himself to a few details of their experiences and results from the three methods of the British, German, and American "Pharmacopœias," and after "making two or three dozen determinations of morphia by the B.P. process finally abandoned it altogether." In so doing we hold him to be fully justified, even without the dozens of determinations he speaks of. He regards himself and pupils as having been "in the same predicament" as ourselves in taking a wrong quantity of solution of opium. Now we take leave to disclaim having been in any predicament. We had to follow the published process of the "Brit. Pharm.," whether right or wrong, to attain our object. Not so Mr. Williams, to whom the correction of an obvious blunder was open, if he so pleased, instead of observing that there was "no clear reason" for it, in which he is most correct, seeing that no reason exists, whether clear or obscure, for this error being made and left unaltered; nevertheless the evident blunder was always followed in his determinations. The German and American methods are equally condemned, and as the Persian pupils have vanished from the scene it is obvious that these gentlemen must either be examining opiums by faulty methods, or have given it up as a bad job.

Our author proceeds to detail a process which is nearly identical with that of Mr. Stillwell, even to the rubber-tipped glass rod, but uses far more alcohol, and omits the "wash well with ether" of Mr. Stillwell, which makes it certain that his results are less accurate than those of Mr. Stillwell. Mr. Williams now refers to the titration of morphia, a subject which may be more conveniently considered later on. Then his readers are informed that "during the last few months he has slightly altered his methods of estimating the amount of morphia in opium. This alteration proves to be the use of 200 grains of opium, 100 fluid grains of alcohol, 600 of ether, and 45 of solution of ammonia, double his former quantities, "the remainder of the process to be conducted as usual," a curt and meaningless direction. Mr. Stillwell, we observe, has most wisely devoted several pages of his pamphlet to minute directions to be followed by the analyst.

In these processes Mr. Williams has been guilty of plagiarism from Mr. Stillwell, whilst omitting the careful and continuous use of ether on which Mr. Stillwell lays great stress. Mr. Williams, in describing these methods, "began a series of experiments," speaks of "my general plan of procedure" and "my present methods," but never mentions Mr. Stillwell in connection with them, whilst telling the readers that he "latterly placed implicit reliance on the methods which I have just described," and again, that "my results were obtained by the process upon which I have latterly staked my faith." This *staking of his faith* seems to us to be an excellent illustration of Pope's axiom—

"Your true no meaning puzzles more than wit."

We may now return to the question of titration. Mr. Williams observes :—"Unless I mistake their meaning, Messrs. Teschemacher and Smith appear to be under the impression that they are the only chemists who test the purity of the morphia precipitate by titration with standard acid." Mr. Williams has read our paper, and should be surprised to find that he is utterly mistaken both as to our statement, which was that "titration has not been used by any of the chemists whose processes we have investigated," and also as to the meaning he has contrived to attach to it. He then refers us to a letter of his in the Chemical News, vol. lv., p. 69, wherein he says:—"I check my results by titrating the precipitate with decinormal sulphuric acid. The titration with acid generally gives figures from 0·10 to 0·25 per cent lower than those obtained by simply weighing the morphia." Surely this titration might be as well omitted. Any process which will yield within 0·10 to 0·25 per cent of morphia might be gladly accepted as most satisfactory. For ourselves, we cannot accept this statement as meaning what it says, whatever it has been meant to convey. It is wholly opposed to our own experience, as we state in our directions where treating of the use of benzene, that morphia is thus obtained "free from other opium alkaloids and narcotin, but still containing colouring and possibly

other organic matters to the extent of 3 to 10 per cent." Mr. Williams seems to have acquired the art of using language significant to himself if puzzling to his readers. We have already adduced instances of this, but no more striking examples can well be met with than in this letter of his in 1887, wherein he seeks to vindicate his claim to the advocacy of titration in determining the amount of morphia present in opium, which was made known to us and other analysts by Mr. Allen in 1882, so that we fear that his claim must be rejected. Again he "highly recommends Mr. Stillwell's method, as it may be relied upon to extract *all* the morphia present, which most other processes fail to do." The italics are Mr. Williams's, as if he desired to emphasize a statement which, oddly enough, is the very reverse of his presentment. We greatly doubt whether any method fails "to extract *all* the morphia present." The true *crux* and difficulty is to *isolate* the morphia and determine its amount when extracted.

To our judgment Mr. Stillwell has succeeded more nearly than any chemist we have so far met with in determining the amount of morphia present in opium, and this is, in the main, owing to his taking pains and to a lavish use of ether in the hope of getting rid of the narcotin. He would have taken a further step forward had he anticipated the utility of employing sections 6 and 7 of our method, and even using ether to the finely-ground supposed morphia instead of benzene, a reagent which has been steadily ignored by chemists, although advised by us more than a decade since.

In conclusion we must ask our readers to remember that we have never placed implicit reliance on our method, nor asserted our belief in its giving accurate results, nor staked our faith upon it, but were content to say "All we pretend to do is to return results certifying to the amount of pure crystallised morphia which can be obtained from a given sample of opium. And further, that we can and do obtain more morphia than has been procured from opium by other analysts."

ON A CYANIDE OF ARSENIC.

By G. W. BLYTHE.

In reading the various works on chemistry I have noticed that, although many arsenic compounds are there mentioned, yet the cyanide, AsCN, is left out; and I therefore judged from this that it had not yet been discovered. I further considered that, as prussic acid is obtained by the reaction of hydrochloric acid on various cyanides, cyanide of arsenic might be formed by the reaction of arsenious chloride on some cyanide, such as that of mercury, silver, or sodium. I therefore introduced arsenious chloride and mercury cyanide into a retort, connected with a cooled receiver, and distilled. Presently a colourless volatile liquid, exactly resembing in appearance and odour prussic acid, passed over, but, coming into contact with some moisture (the retort and receiver had been rinsed, but not dried) a white powder made its appearance, upon seeing which I immediately conjectured that cyanide of arsenic *had* been obtained and had been decomposed by the moisture (just as the corresponding chloride is under similar circumstances) into arsenious and prussic acids.

A ferrocyanide of arsenic, but in combination, has been discovered for some time, and will be found mentioned in "Ure's Dictionary."

Previous to *really* discovering cyanide of arsenic I had thought that it might be produced by distilling white arsenic with strong prussic acid or a saturated solution of cyanide potassium; but only prussic acid seems to pass over. The odour of the prussic acid passing over in this instance certainly differed from that of prussic acid obtained by the usual methods, not being so sweet or fragrant.

Perhaps cyanide of arsenic might also be obtained by distilling in the dry way one part of metal arsenic with six parts of mercury cyanide, just as the corresponding chloride is prepared by distilling one part arsenic with six parts mercuric chloride; but I have not tried this way.

VOLUMETRIC DETERMINATION OF BROMINE.

By JOHN TSAWOO WHITE.

Little did I dream that the factor 1·6 found for bromine rested on a miscalculation. I find that the factor for the thiosulphate solution is 1·5 times its assumed value. The values of the bromine found thus becoming, without the use of an extra factor, still less, further experiments became necessary.

A zinc bromide solution was prepared by digesting silver bromide with zinc and water. The bromine was determined, after liberating it with potassium permanganate and sulphuric acid, by decinormal thiosulphate. Then the bromine liberated by permanganate and aluminium sulphate was determined with the following results: any errors due to the thiosulphate solution will be eliminated.

Taken.	Found.
0·0086	0·0078
0·0430	0·0411
0·0430	0·0430

The permanganate used in former experiments was far too large. 10 c.c. of a solution, 1 in 25, will be sufficient for 0·1 grm. Br. The aluminium sulphate is added when everything is ready for the distillation to guard against loss of bromine. Neither potassium bromide nor zinc bromide gives off bromine when boiled with potassium permanganate alone. Mixtures with chlorides and iodides were not tried, as former experiments showed that chlorine and iodine are not evolved. This reaction of bromine with potassium permanganate and aluminium sulphate may be used for its detection, and for preparing it pure, perhaps on a manufacturing scale, instead of the present fractionation process.

Rangoon College, May 22, 1888.

LONDON WATER SUPPLY.

REPORT ON THE COMPOSITION AND QUALITY OF DAILY SAMPLES OF THE WATER SUPPLIED TO LONDON FOR THE MONTH ENDING MAY 31ST, 1888.

By WILLIAM CROOKES, F.R.S.;
WILLIAM ODLING, M.B., F.R.S., F.R.C.P.,
Professor of Chemistry at the University of Oxford;
and C. MEYMOTT TIDY, M.B., F.C.S.,
Professor of Chemistry and of Forensic Medicine at the London Hospital; Medical Officer of Health for Islington.

To General A. De Courcy Scott, R.A.,
Water Examiner, Metropolis Water Act, 1871.

London, June 7th, 1888.

Sir,—We submit herewith the results of our analyses of the 182 samples of water collected by us during the past month, at the several places and on the several days indicated, from the mains of the seven London Water Companies taking their supply from the Thames and Lea.

In Table I. we have recorded the analyses in detail of samples, one taken daily, from May 1st to May 31st inclusive. The purity of the water, in respect to organic matter, has been determined by the Oxygen and Combustion processes; and the results of our analyses by these methods are stated in Columns XIV. to XVIII.

We have recorded in Table II. the tint of the several samples of water, as determined by the colour-meter described in a previous report.

In Table III. we have recorded the oxygen required to oxidise the organic matter in all the samples submitted to analysis.

The waters during May have fully maintained their excellent and unimpeachable character for purity.

The slight turbidity recorded in some half dozen samples supplied by the East London Water Company, is explained by certain local disturbances, consequent upon fixing many hundred hydrants, in accordance with directions received by the Company from the Metropolitan Board of Works. The operation of fixing a hydrant necessarily involves the scouring and disturbance of a long length of main. The organic matter in the East London Company's water, however, during May, shows a reduction over that of last month, the oxygen required per gallon (on the average) to oxidise the organic matter being 0·036 grain during May, against 0·044 grain during April.

We are, Sir,
Your obedient Servants,
William Crookes.
William Odling.
C. Meymott Tidy.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Ordinary Meeting, June 7th, 1888.

Mr. William Crookes, F.R.S., President, in the Chair.

Professor Ferguson and Messrs. John Campbell Fell and Thomas E. Lindsey were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs. Walter Bromley Cooley, 5, Dudley Street, Wolverhampton; Archibald Carlyle Mounsey Ingram, 5, Buchanan Terrace, Paisley; Walter M. Gardner, Brookfield Terrace, Headingly, Leeds; Frank Pullinger, B.A., Alexander Park, Oldham; Clement T. Rhodes, 18, Bute Street, South Kensington.

The following were elected Fellows of the Society:—Messrs. Joseph Campbell, John Dunn, William Burns-Featherstone, Albert L. Guiterman, James C. Hamilton, James Mair, B.Sc., John James Morgan, Edward W. A. Augustine Mayhew, Frederick Ernest Pollard, Albert John Sach, Mark S. Wade, M.D.

The following papers were read:—

45. "*The Chemical Action of some Micro-organisms.*" By R. Warington.

The organisms whose action has been studied were *B. subtilis;* two bacilli isolated from soil; one from a visible growth in a solution which had nitrified; a micrococcus isolated from another culture in which it was present as an impurity; 18 organisms, many pathogenic received from Dr. Klein, F.R.S., and one from Dr. W. R. Smith.

1. *The Hydrolysis of Urea.*—The ability of each organism to render a sterilised 25 per cent solution of urine alkaline was tested. In every case but two there was either no increase of alkalinity in one week at 22°, or the increase was so slight that it could not be safely concluded that ammonia was produced. In the case of the *M. ureæ* isolated by Dr. Smith, a rather considerable increase of alkalinity took place. A somewhat smaller but very distinct increase occurred with *B. fluorescens non liquescens.* A much larger increase of alkalinity than in either of these instances was obtained when the urine was seeded with a fragment of arable soil.

2. *Behaviour in Milk.*—The curdling of milk by micro-organisms is effected either by the production of lactic acid, or apparently by the formation of a rennet-like ferment. The amount of lactic acid required to curdle milk depends on the temperature, the amount being smaller the higher the temperature.

Among the organisms examined five have distinctly acidified milk, but in very different degrees. *Staphylococcus candidus* produces too little acid to cause curdling, even when the milk, after acidification, is placed in boiling water. The bacillus of infantile diarrhœa and *B. termo* produce a greater acidity, curdling milk speedily at 32°, but fail entirely to curdle it at 22°. *M. gelatinosus* curdles milk speedily at 22°, and even at 10° after many days. The two organisms, *B. fluorescens liquescens* and Koch's chlorera spirillum, curdle milk readily at 22°, without producing any appreciable acidity; the latter organism will indeed curdle milk made alkaline with sodium carbonate without destroying the alkalinity. We have here, apparently, a typical case of curdling by means of a ferment. Two of the acidifying organisms which curdle milk, *M. gelatinosus* and *M. ureæ*, act apparently in part by means of a ferment, as the acidity produced by them when the milk is curdled is quite insufficient in itself to effect curdling at the temperature of the experiment. Soil from an arable field readily curdles milk, even at 10°, but without producing at the time an appreciable acidity; it acts plainly by a ferment. During the action of soil on milk much gas is evolved, even at 10°. No gas was observed during the action of any of the organisms examined, save in an experiment with the bacillus of infantile diarrhœa at 37°.

Five organisms, *B. subtilis*, *B. anthracis*, *B. floccus*, *B. toruliformis*, and Finkler's comma are active peptonisers. The milk, after a few days at 22°, becomes clear immediately beneath the surface, and this clear space slowly extends till the whole of the milk has lost its opacity. On moving the tube after the action has begun, it is found that the opaque portion is more or less gelatinised. The clearing of the milk is due to the gradual dissolution of the jelly. The clear fluid is rich in peptone. It has been supposed that the liquefaction of gelatin by bacteria is due to the production of a ferment. The whole of the liquefying bacteria experimented on show evidence of the formation of ferments when grown in milk. The organisms which simply acidify do not liquefy. Soil peptonises after curdling, the curd first formed slowly redissolving. A small class of organisms, *B. fluorescens non liquescens* and the bacillus of septicæmia (mouse and guinea-pig), render milk after a time decidedly alkaline, and the milk from this cause loses much of its opacity, but no other change is produced. Several organisms grow freely in milk without altering its appearance or its reaction to litmus-paper. Cultivation in milk is an excellent method of distinguishing micro-organisms, the possible results being very varied, especially when the effect of temperature is observed.

3. *Reduction of Nitrates.*—Nearly the whole of the organisms examined have been cultivated both in broth containing nitre and in a 20 per cent solution of urine containing nitre, and generally at two temperatures, 20—23° and 32—37°. The experiments were made in half-filled bottles with cotton-wool stoppers. The amount of nitrate reduced in urine was always small, and varied probably on account of the variable composition of the medium. The reduction of nitrate in broth was frequently both rapid and very considerable. In cases in which the organisms would bear a high temperature the reduction was always more energetic at the higher than at the lower temperature. The organisms which appeared to possess the greatest power of reducing nitrates to nitrites were—

B floccus, *B. fluorescens non liquescens*, B. of swine fever, *M. ureæ*, *M. gelatinosus*, *Staph. candidus*, *Staph. luteus*. Next to these stand the following, which also reduce nitrates freely:—*B. termo*, B. of typhoid fever, B. of infantile diarrhœa, B. of cholera, B. of septicæmia, *B. anthracis*, B. Denicke's comma, *Staph. albus liquescens.*

Far below these comes *B. subtilis*, which produces no

nitrite in the urine solution, but always yields, after some time, a trace of nitrite in broth at the lower temperature, and a much more marked amount at the higher temperature. *Streppococcus scarlatinæ* yields a mere trace of nitrite in broth cultures.

The following organisms failed entirely to effect reduction to nitrites:—*B. fluorescens liquescens*, *B. toruliformis*, *B. sulphureus*, B. Finkler's comma, *B. comma noma*, *M. aureus*.

Most of the non-reducing organisms were also cultivated in broth containing nitre covered by a layer of paraffin oil, by which means the access of oxygen was to a considerable extent excluded. In no case was any reduction of nitrates observed.

No evolution of gas was noticed in any of the above cultivations. In experiments made in solutions seeded with arable soil, air being excluded, the reduction of nitrates was complete, gas being evolved, neither nitrate nor nitrite remaining.

4. *Oxidation of Ammonia to Nitrate.*—Solutions of various compositions were employed, in all of which the addition of a little soil produced active nitrification. Nearly all the organisms already enumerated were sown in one or other of the solutions, and some in several different solutions. In no case was nitrification certainly observed. Minute traces of nitrate were in some instances found, but these always failed to increase. The author now proposes to commence a systematic study of the organisms contained in soil.

Discussion.

Dr. Percy Frankland said that he also had so far searched in vain for the nitrifying organism; but he could not agree that no one had been successful. Heræus had succeeded in isolating two or three organisms which were stated not only to induce the formation of nitrite in urine solutions, but also in mineral solutions containing ammonium salts. He had, however, himself shown that Heræus was undoubtedly wrong in attributing nitrifying powers to a number of organisms, his mistake arising from his ignorance of the fact that nitric acid is normally present in urine. The effects of organisms in milk had been very fully described by Hueppe, who had shown that coagulation might take place independently of the presence of acid. He was not satisfied with the method adopted by Mr. Warington for sterilising milk—perhaps the most difficult of all fluids to sterilise; sterilisation might, however, be effected by heating on five successive days at a temperature of 65—70°, and it had long been known that milk so treated differed from steam-sterilised milk. Had Mr. Warington repeated the experiments sufficiently often to be sure of the results being constant? micro-organisms were often extremely capricious in their chemical action. Thus, under certain conditions, *M. prodigiosus* entirely changed its character—becoming colourless, but the colourless form would regain the pigment-producing power on changing the cultivating medium.

Mr. Warington, in reply, said that he was under the impression that Heræus had found nitrification to take place only in those cases in which soil was introduced into the experimental fluids. The results he had obtained when using milk were perfectly constant, and he had met with no failures in sterilising; this probably was attributable to the fact that he had used fresh country milk, milked directly into sterilised bottles. He had observed the change in colour of *M. prodigiosus*, but Dr. Klein, to whom he submitted his cultures, had found that the forms were distinct, and that only white organisms could be obtained from the pure white form.

46. "*The Optical and Chemical Properties of Caoutchouc.*" By J. H. Gladstone, Ph.D., F.R.S, and Walter Hibbert, F.I.C.

This is an extension of the observations on caoutchouc published in Dr. Gladstone's paper on Essential Oils (*Chem. Soc. Trans.*, 1886, 609). The substance experimented on was obtained from the best commercial Para rubber. Many attempts were made to separate the two supposed modifications, and to remove an oxidised product. The most promising method seemed to be to dissolve the rubber in cold chloroform and precipitate partially with a little alcohol, but no good separation was effected, and the results of analysis gave usually about 3 per cent of oxygen. One small specimen, very carefully prepared and dried, contained carbon and hydrogen in almost exactly the proportions $C_{10} : H_{16}$, with only 0·5 per cent deficiency.

Optical analyses are given of 17 preparations dissolved in benzene. They were prepared from different specimens in different ways, and variously dried, and two of them were second precipitates from chloroform or ether solutions. The refraction and dispersion equivalents vary considerably, but they all agree in showing that the $C_{10}H_{16}$ must have more than one pair of carbon-atoms doubly linked. All the dispersion equivalents and 11 of the refraction equivalents also exceed what theory requires for two pairs of carbon-atoms so combined, namely, refraction equivalent, 75·2, and dispersion equivalent, 4·8. They fall short of what would be required by three pairs, at any rate in the case of refraction (theory, refraction equivalent, 77·4, and dispersion equivalent, 5·6), but the presence of a little oxygen in the substance examined would reduce the refraction and dispersion considerably. The observations on the best specimen already described give the highest figres, the mean of which are, refraction equivalent, 77·23, and dispersion equivalent, 5·50. There is little doubt, therefore, that the main constituent of caoutchouc is a compound which has three pairs of carbon-atoms doubly linked. If this be the case, the molecular formula cannot be C_5H_8, like isoprene, or $C_{15}H_{24}$, like cidrene, as these would give respectively one and a half and four and a half pairs of carbon-atoms, united by double linking. It cannot contain the hexagonal ring, but must be expressed graphically by a chain formula. This may account for the wide difference of properties between caoutchouc and the various essential oils.

The action of the halogens on caoutchouc dissolved in chloroform was examined. Chlorine gave rise to a substance which could be obtained in yellow scales, the best preparation giving figures which seem to point to $C_{10}H_{14}Cl_8$. Bromine in weak solution acts upon caoutchouc in chloroform, and by volumetric methods it was determined that 136 grms. of the caoutchouc used combine with 303 grms. of bromine on an average, which indicates $C_{10}H_{16}Br_4$ as the first product of the action. The prolonged action of bromine causes the separation of hydrogen bromide, and the formation of a compound precipitable by ether as a white solid, $C_{10}H_{15}Br_5$. It seems not improbable that this is formed from a compound, $C_{10}H_{16}Br_6$, by the elimination of HBr. Iodine has no action.

The action of heat was also studied. The caoutchouc hydrocarbon dissolved in toluene remains unchanged optically on exposure to a temperature of 200°.

As is known, the various oils given by dry distillation contain carbon and hydrogen in the same proportions as the original caoutchouc, but the structural re-arrangement is most materially modified, as indicated by the following optical constitutional formulæ:—

Caoutchouc.. $n C_6'' C_4H_{16}$, Caoutchene.. $C_4'' C_6H_{16}$,
Isoprene. .. $C_4'' CH_8$, Heveene. .. $n C_2'' C_3H_8$.

47. "*An Apparatus for Maintaining a Constant Pressure when Distilling under Reduced Pressure.*" By W. H. Perkin, F.R.S.

The essential parts of the apparatus are a barometer tube in connection with the exhausted apparatus, and a valve through which air is admitted when, by the action of the pump, the pressure becomes reduced below the prescribed point. A copper rod armed with a platinum point passes through the upper end of the barometer tube.

and can be adjusted at any desired height; so soon as the mercury rises and touches the point of the rod an electric circuit is completed and the valve is raised and air admitted. The valve is a glass sphere in a glass seating, the sphere being suspended from the armature of an electromagnet; the sphere has a weight attached to it, which causes it at once to fall back when the circuit is broken. Even under a pressure of 60 m.m.—the lowest obtained with the water-pump used—the apparatus renders it possible to maintain the pressure constant to within a millimetre.

PHYSICAL SOCIETY.

June 9th, 1888.

Professor REINOLD, F.R.S., President, in the Chair.

MR. J. L. HOWARD, D.Sc., was elected a Member of the Society.

The following papers were read:—

"*On the Analogy between Dilute Solutions and Gases as regards Gay-Lussac's and Boyle's and Avogadro's Laws.*" By Prof. VAN'T HOFF. Presented by Prof. RAMSAY, F.R.S.

If a dilute aqueous solution of sugar (say 1 per cent) be placed in a vessel, A (the walls of which are permeable to water but not to sugar molecules), and immersed in a large quantity of water, B, water will pass from B to A until a certain difference of pressure exists between the inside and outside of A, that difference depending on the temperature and concentration of the solution. The pressure is called *osmotic pressure*, and the walls of A are said to be *semi-permeable*. Such a vessel may be artificially produced by depositing ferrocyanide of copper on unglazed porcelain, but many of the experiments dealt with in the paper have been made with the cells of plants, the walls of which form good *semi-permeable membranes*. At constant temperature the osmotic pressure is found to be proportional to the concentration of the solution, and for a given concentration the pressure is proportional to the absolute temperature. Similar results have been obtained with solutions of KNO_3, K_2SO_4, NaCl, &c., and Soret has found that if a solution be heated unequally at different parts the warmer parts are less concentrated, just as in gases under similar conditions the warmer parts are more rarefied. The numerical results are in fair accordance with those deduced from the laws above stated. Theoretical proofs of the laws are given in which reversible cycles and the second law of thermodynamics are made use of. By similar reasoning the author concludes that "under equal osmotic pressure, and at the same temperature, equal volumes of all solutions contain the same numbers of molecules, and, moreover, the same number of molecules which would be contained in a gas under the same conditions of temperature and pressure. These results are confirmed by Pfeffer's direct determinations of osmotic pressure and Raoult's experiments on the "molecular lowering of vapour pressure," and the "molecular depression of the freezing-point of the solvent." The latter part of the paper contains applications to chemical phenomena.

Prof. RÜCKER regretted that the names Boyle's Law and Gay-Lussac's Law had been so persistently made use of in the paper, as he thought a wrong impression would be spread as to the nature of the phenomena. He also considered it probable that the proportionality observed was merely the result of the smallness of the ranges over which the experiments had been made.

Mr. H. CROMPTON took exception to the imaginative character of the reasoning, and thought much more experimental proof was required before the results could be accepted for any but very small ranges of concentration.

In answer to Prof. Reinold, Prof. RAMSAY said the experimental data were not obtained by van't Hoff himself, but were taken chiefly from Raoult's determinations.

"*On a Method of Comparing Very Unequal Capacities.*" By Mr. A. H. FISON, D.Sc.

One coating of each condenser is joined to earth, and to one end, A, of a high resistance (20,000 or 30,000 ohms) through which a current is flowing. The small condenser is charged to the P.D. existing between the ends, A, B, of the resistance, and discharged into the large one. This is repeated a great number of times. If C be a point between A and B, the resistance between A and C may be varied until the P.D. between them is equal to that between the coatings of the condensers after n operations. If the insulated coatings be now joined to C through a galvanometer no deflection will result. The relation between the capacities C_1 and C_2 of the large and small condensers is given by—

$$\left(1 + \frac{C_2}{C_1}\right)^n = \frac{R_{AB}}{R_{BC}},$$

where R_{AB}, R_{BC} are the resistances between A B and B C respectively.

Since time is required to perform the operations the instantaneous capacities cannot be compared, and accordingly the measurements are taken after a definite time of electrification.

A special rotating key was shown for performing ten operations per revolution, in which a trigger arrangement was provided for stopping the rotation after a predetermined integral number of revolutions.

The method has been used for comparing a small air-condenser with a microfarad. The capacity of the former was also calculated electrostatically (correction being made for the edges), and that of the latter measured electromagnetically by a ballistic galvanometer. The results give a value for v equal to $2{\cdot}965 \times 10^{10}$. In these experiments the capacity of the rotating key was allowed for. Under favourable conditions capacities in the ratio of 1 to 1000 or 1 to 10,000 can be compared with an accuracy of ¼ per cent.

Prof. AYRTON thought the novelty of the arrangement was in the rotating key, as the method of comparing unequal capacities by charging the smaller and discharging it into the larger a considerable number of times had been described and used by himself and Prof. Perry in their experiments on "The Specific Inductive Capacity of Gases."

Mr. W. LANT CARPENTER exhibited a "*New Form of Lantern*," recently constructed by Mr. Hughes, of Dalston.

The mahogany body is hexagonal, and each of the three front sides is provided with condensers and projecting arrangements. The back side opens to give access to the radiant, which in this case is a Brockie-Pell Arc Lamp, but if necessary a lime light can be readily substituted. The lamp is fixed to the base board, and the body can be rotated through 60° on either side of the central position, thus allowing any of the three nozzles to be directed towards the screen. The three sets of condensers are placed so that their axes intersect at a point about which the radiant is placed. The centre nozzle is fitted as a lantern microscope, with alum cell and various sets of condensing lens and objectives, and a space in front of the main condensers is provided for polarising apparatus. The focussing arrangement consists of a skew rack and pinion and a fine screw adjustment; and the whole microscope can be easily removed and a table polariscope substituted. The right-hand nozzle is arranged for the projection of ordinary lantern slides, and the left-hand one is provided with an adjustable slit for spectrum work. A small table sliding on rails serves to carry the prisms, and the same rails support projecting lenses.

Prof. S. P. THOMPSON congratulated Mr. Lant Carpenter on his selection of the Brockie-Pell lamp as the radiant, for, in addition to its being a focussing lamp, it is unique

in the fact that it works satisfactorily on either constant current or constant potential circuits.

"*Note on some Additions to the Kew Magnetometer.*" By Prof. T. E. THORPE, F.R.S., and Prof. RÜCKER, F.R.S.

In their Magnetic Survey of Great Britain and Ireland the authors have experienced considerable difficulty in making the necessary adjustments of the small transit mirror used for determining the geographical N. point from observations on the sun. To make the required adjustment it is necessary to obtain an image of the cross wires reflected from the mirror, and, owing to the large amount of extraneous light and the insufficient illumination of the cross wire, the image is difficult to see. To exclude extraneous light a tube is placed between the transit mirror and the telescope, and a small screen placed behind the mirror. The cross wires are illuminated by light reflected from a small platinum mirror introduced between the eye-piece and the cross wires, which are viewed through a hole in its centre. The mirror is placed at 45° to the axis, and reflects a considerable quantity of light on the cross wires when directed towards a bright part of the sky. In some cases it is advisable to take observations of the sun without first adjusting the transit mirror, and afterwards correct the error introduced thereby. To do this a finely divided scale is placed in the plane of the cross wires, and from the position of the image, as indicated by the scale, the correction can be made. Observations taken with the mirror in adjustment, and others taken when out of adjustment and subsequently corrected, give very concordant results.

The Rev. Father PERRY said the improvements described were of great importance, for difficulties similar to those experienced by the authors had caused him to abandon the Kew magnetometer for field work, and to use a theodolite instead.

NOTICES OF BOOKS.

A Short Text-Book of Inorganic Chemistry. By Dr. HERMANN KOLBE, late Professor of Chemistry in the University of Leipzig. Translated and Edited by T. S. HUMPIDGE, Ph.D., B.Sc., late Professor of Chemistry in the University College of Wales, Aberystwith. Second Edition, Revised. London: Longmans, Green, and Co.

THE original work of Professor Kolbe is of such excellence that an English version of it might be considered welcome, overstocked as we are with chemical manuals. In noticing the first edition we could not fail to be struck with the editor's statement that in "adapting the book for English students certain alterations and additions were necessary," and that they had been made accordingly with Dr. Kolbe's full consent. In other words, the original work was written for students whose primary object is "to know," and it had to be modified for others whose main purpose is, compulsorily, "to pass." We regret that such should be the case, but we cannot blame the late Prof. Humpidge.

The second edition, now before us, has been completed by Prof. D. E. Jones, in consequence of the lamented death of the original editor. The alterations made are such as recent improvements demand, such as the adoption of the new atomic weight, 9·1, for glucinium, and cannot be said to affect the general character of the work. That in face of the absolute plethora of elementary chemical treatises a second edition should be called for within four years is a proof that its value has been recognised by teachers and students.

Certain Novel Hydrates of the Gases.—M. Villard.—The author has succeeded in combining methane, ethane, ethylene, acetylene, and nitrogen monoxide with water.—*Comptes Rendus*, Vol. cvi., No. 23.

CORRESPONDENCE.

SOLUTION.

To the Editor of the Chemical News.

SIR,—Will you allow me a few words in reply to Professor Pickering's letter in CHEMICAL NEWS, vol. lvii., p. 220. It would take up too much of your valuable space to enter into the subject fully, as the proofs of my theory of solution are cumulative, and do not depend on any one set of phenomena, and I based it originally on very different data from thermo-chemical results, and only brought forward these as striking corroborations of its truth.

Prof. Pickering quite ignores the *inverse* relations I pointed out in my last communication, which indeed are the essential points. I do not know if he accepts as generally true the results of the researches of Thomsen and others, that the heats of combination, solution, &c., are really represented by the number of heat units given. If he does not, then I have nothing more to say: his difference is with those authors, as I carefully stated in my various papers on the subject that my arguments were based on the assumption that these were actual facts. If he does, then the relations pointed out are simply statements of facts, however obtained, which he admits. He says these relations are due to N being constant in these salts. Now this appears to me much the same thing as saying that in various accounts of different amounts the relations of the various operations in these accounts are due to the balance being always the same. This is to invert the order of things altogether; the balance is the same because of certain relations existing between the operations. N really represents no definite operation whatever, and is simply the balance remaining after many chemical changes, and is constant in these cases because the heats of solution, &c., vary in the manner I have pointed out. Prof. Pickering acknowledges his errors so frankly, although he endeavours to get out of them by the rather clumsy method of showing that they neutralise one another, that I have a better opinion of him than he seems to have of himself, judging by the last paragraph of his letter.—I am, &c.,

WILLIAM DURHAM.

ALUMINIUM IN IRON.

To the Editor of the Chemical News.

SIR,—I should be glad if some of your readers would give me some information on the following facts. There are some aluminium alloys with iron in the market for use in steel making of which it is said "that it is practically impossible at present" to ascertain by analysis the presence of aluminium "at all by any known method," for the apparent reason "that other constituents are mistaken for it."

Have your readers any experience of this difficulty and why it cannot be identified by the usual method of separation from iron by means of pure sodium hydrate. The alloys in question are perfectly soluble in aqua regia, and ought certainly to be amenable to the usual methods.—I am, &c.,

ENGINEER.

APPARATUS FOR GENERATING GASES.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. lvii., p. 241, there is a communication from Mr. Coram, of Finsbury Technical College, to the effect that an apparatus for generating gases, described by Mr. Johnson, of King's College, is not new, and adding that he has had a similar apparatus in use nine months.

May I be allowed to point out to the two gentlemen

concerned that precisely such an apparatus was in use in Professor Bunsen's laboratory at Heidelberg so long ago as 1879, at which period I had the honour of studying there. The apparatus I speak of was principally used for the evolution of CO_2, and was essentially as described by Mr. Johnson, with one notable exception—the exit tube was provided with a stopcock, thus enabling the evolution of gas to be stopped immediately. The stopcock being closed the pressure of the CO_2 forced the HCl out of the generating tube, thus leaving the whole apparatus non-acting; all that need be done for a fresh experiment was to open the stopcock, when in flowed the acid, and evolution re-commenced.—I am, &c.,

George H. Bostock.

Messrs. J. Muspratt and Son's Laboratory,
Widnes, June 19th, 1888.

[We have received other communications saying that similar apparatus to the one recently described in our pages by Mr. Johnson has been for some years in use in various chemical laboratories. This is a proof that the device is useful, and the thanks of chemists are therefore due to the one who first publishes this information to the world.—*Ed.* C.N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed,

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 23, June 4, 1888.

Action of Alkaline Phosphates upon the Alkaline-Earthy Oxides.—L. Ouvrard.—Baryta is characterised by its resistance to the formation of double salts and to displacement by alkalies. Lime, on the contrary, merely yields double salts, whilst strontia takes an intermediate position.

A Contribution to the Study of the Ptomaines.—Oechsner de Coninck.—The author has prepared two chloro-mercurates and an iodomethylate of the ptomaine $C_8H_{11}N$. The iodomethylate of this ptomaine behaves in the same manner as the iodomethylates of the pyridic bases in presence of an alkaline lye. Certain pyridic bases, extracted from Dippel's oil, present under similar conditions reductive powers as remarkable as that of the novel ptomaine.

Researches on the Fixation of Nitrogen by the Soil and by Plants.—Arm. Gautier and R. Drouin.—The authors have analysed the part played by the different elements of a fertile soil, mineral or organic, living or lifeless, in the fixation of atmospheric nitrogen, whatever may be the form in which such nitrogen exists in the air. As to the reality of the phenomenon of the assimilation of free nitrogen, that is a point upon which they have expressly reserved their conclusions.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. Series 5, Vol. iii., No. 27.

This issue contains no original chemical matter.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 6.

Criticism of the Direct Methods for Determining Tartaric Acid in Lees and Argols.—Dr. Anton Borntträger.—The author examines the application of the method of Warington and Grosjean in various cases.

Determination of Tartaric Acid.—F. Gantter.—The author pronounces the method of Goldberg (*Zeitschrift Anal. Chemie*, xxii., p. 270) very satisfactory where it is merely required to determine total tartaric acid, whether existing as potassium bitartrate, calcium tartrate, or in the free state. The conditions for the success of the process, as investigated by Weigert, are that the excess of potassium carbonate must be as small as possible, acetic acid must be added in corresponding excess, the washing must be prolonged, and the mixture of potassium carbonate and neutral tartrate must, on admixture with alcohol, still contain water.

Determination of the Free, Semi-combined, and Combined Carbonic Acid in Neutral Mineral Waters.—W. Borchers.—The author refers to a process for this purpose which he described in the *Journal fur Prakt. Chemie* (xvii., 353) as early as 1878. He mentions then and there that the results are the more accurate the less alkaline bicarbonate is present. He therefore adds to waters containing such alkaline bicarbonates a soluble neutral salt of the alkaline earths, preferably barium chloride, thus producing an alkaline chloride and, *e.g.*, barium bicarbonate. The latter, on heating, is decomposed into free carbonic acid and barium monocarbonate. The quantity of crystalline barium chloride to be used for 300 c.c. of water is 1 to 1·5 grm.

Filtering Flask with a Ground Funnel.—F. Allihn.—This apparatus, which is shown in the figure, is for use in combination with a filter-pump.

A Steam-Calorimeter.—R. Bunsen.—The principle is bringing a substance of a known low temperature into a current of saturated watery vapour of a known temperature and heating it there to the temperature of the steam. A certain quantity of liquid water is then deposited upon the substance and its weight is determined. The quantity of this water depends exclusively upon the quantity of heat used in heating the substance. See also J. Joly in *Proc. Royal Society* for November, 1887.

Pipette for Measuring Bromine.—A. Simon.—This apparatus is distinguished from ordinary pipettes by its capability of being closed at the lower end by a small glass bead weighted with mercury and drawn out at one side to thread of moderate thickness, and projecting out of the pipette about 2 m.m. The bromine is kept under water. The pipette is thrust first into the stratum of water, a little water is allowed to enter by tapping the pipette, which is then thrust down to the bottom. The valve rises and bromine enters, and can be raised by suction to any required height.

The Different Systems of Filter-pumps.—T. Fairley.—From the *Journal of the Society of Chemical Industry.*

An Improved Funnel.—C. Nickels.—From the *Journal of the Society of Chemical Industry.*

Apparatus for the Continuous Development of Gases.—G. Tissandier.—From the *Bulletin de la Société Chimique.*

Maintenance of Constant Temperatures.—W. Ramsay.—From the *Journal of the Chemical Society.*

An Annular Burner for Heating the Upper Part of Crucibles.—W. A. Shenstone.—From the *Journal of the Chemical Society.*

Arrangements for the Evaporation of Fluids by Heat from Above.—J. W. Gunning.—The arrangement consists of an iron plate supporting the crucible and standing on four feet. Through four holes in the plate near its corners there project four large Bunsens, whose flames burn above the bottom plate. Above the whole there is placed a heavy cast-iron plate resting upon four taller feet, and projecting beyond the bottom plate on all sides. The hot air thus produced and the radiating heat from the upper plate quickly evaporate the liquid without danger of spirting.

A Smelting Furnace. — A. Gawalowski. — This apparatus cannot be intelligibly described without the accompanying figure.

Titration of Solutions of Iodine.—W. Kalmann.—The author dilutes with water, introduces sulphuretted hydrogen until the colour is discharged, and then titrates with decinormal soda, using methyl-orange as an indicator.

Determination of Small Quantities of Sodium Chloride along with Potassium Chloride.—F. Röttger and H. Precht.—The authors had previously proposed to grind the sample to a fine powder, put 20 grms. into a beaker along with 40 grms. alcohol at 90 per cent, stir frequently with a glass rod, and, after standing for half an hour, add drop by drop ½ c.c. of a 10 per cent solution of potassium carbonate, stirring meanwhile. The liquid is separated from the undissolved portion by decantation, filtration, and washing, and in the weighed residue from the evaporation of the alcoholic solution the potassium chloride is determined as usual and the sodium chloride is determined as difference. As an abbreviated process the authors place 20 grms. of the mixture in a flask graduated to 110 c.c., fill up to three-fourths with alcohol at 90 per cent, shake frequently, and after half an hour add ½ c.c. of a 10 per cent solution of potassium carbonate, fill up to the mark, and shake well. Of the clear liquid 50 c.c. are then treated as above directed.

Volumetric Determination of Chromium.—W. J. Sell.—From the CHEMICAL NEWS.

Analysis of Nickel.—G. Langbein.—In the electrolytic separation of nickel from an ammoniacal solution containing nickel and manganese the latter metal does not, as it is commonly assumed, deposit completely at the positive electrode, but the nickel deposited at the negative electrode contains metallic manganese, varying in quantity according to the strength of the current. To avoid this error the ammoniacal solution of nickel must be made free from manganese, which is effected by precipitating the iron oxide present by means of ammonia in the absence of ammonium chloride, and thus effecting the simultaneous elimination of manganese.

Separation of Nickel from Chrome Iron, Manganese, and Aluminium in Ores, Slags, &c.—Thomas Moore.—From the CHEMICAL NEWS.

Indirect Determination of Fluorine.— S. Bein.— This paper requires the accompanying figure. A. E. Haswell points out that Bein's method had been previously used by Ketzinsky for detecting fluorine in minerals and and in the ash of plants.

The Indirect Determination of Chlorine, Bromine, and Iodine by the Electrolysis of their Silver Compounds, and Experiments on the Transformation of these Silver Compounds by Means of the Halogen Compounds of the Alkali Metals.—In general either the mixture of the silver chloride and bromide is converted into metallic silver by reduction in a current of hydrogen, or it is converted into silver chloride by heating in a current of chlorine. Both these methods are rendered inaccurate by the possible volatilisation of a little silver. A different method has been proposed by F. Maxwell Lyte in the CHEMICAL NEWS (xlix., 3).

Execution of the Thalleioquin Reaction. — G. Vulpius.—The author proposes instead of chlorine water the use of potassium chlorate and hydrochloric acid. For the reaction to succeed it is necessary that there should be an excess of hydrochloric acid, so that no potassium chlorate may remain undecomposed.

Detection of Bromine in the Alkaloidal Hydrochlorates.—A. Weller.—In many of these compounds bromine cannot be detected by the direct addition of chlorine water and shaking with carbon disulphide, as the bromine at once forms compounds with the alkaloids which discolour the carbon disulphide. In the case of quinine, quinidine, cinchonine, cinchonidine, strychnine, and morphine the alkaloid is precipitated with soda-lye; morphine is thrown down with sodium carbonate and codeine with the same reagent.

The Alkaloids of Aconitum Napellus.—A. Jürgens. —The chemico-forensic detection of aconitine can be effected only by means of physiological experiments. The colour-reactions with phosphoric acid, sulphuric acid, and sugar, with phospho-molybdic acid and ammonia, are not produced with pure aconite.

Wrightine and Conessine.—According to Warnecke Polstorff, and Schirmer, these two bases are homologous, but not identical. Identity is not, however, excluded in view of their percentage composition and their melting-points.

Alkaloids and Jaborandi Leaves.—Eric Harnack.—From *Liebig's Annalen*.

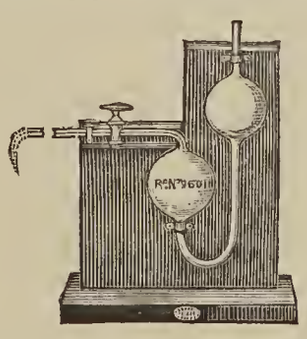
Differences in the Reactions of Strychnine and Gelsemine.—M. Raimondi.—To avoid confounding these two alkaloids the author specifies the following characteristic points :—On contact with potassium dichromate and terhydrated sulphuric acid, gelsemine gives a sky-blue colour traversed by green stripes, finally becoming entirely green. Strychnine, on similar treatment, gives a violet, changing to brick-red, and turning yellow on dilution. Strong sulphuric acid dissolves gelsemine with a yellow-brown colour, turning purple-red on heating; whilst strychnine dissolves colourless in the cold, turning yellowish brown on heating. Strong sulphuric acid and sugar colour gelsemine reddish blue, whilst strychnine is not coloured in the cold.

Detection of Glucose.—C. Agostini adds to 5 drops of the liquid in question 5 drops of a solution of gold chloride (1 : 1000) and 2 drops of a solution of caustic soda (1 : 20), and heats to a boil. On cooling, if glucose is present, there appears a splendid violet colour.

A Modification of the Process of Dumas for the Determination of Nitrogen.—M. Raulin.—From the *Bulletin de la Soc. Chimique*.

MISCELLANEOUS.

New Gas-pipette.—We beg to call the attention of chemists to an improved form of Hempel's gas-pipette, recently devised by Messrs. Harris and Co., of Birmingham. This pipette differs from the ordinary type by having, instead of the long capillary tube, a capillary tube with a stop-cock at its centre, bent at right angles from top of bulb. These pipettes are made with the end of the capillary tube straight, or bent at right angles and drawn out to a point. The pipettes can be used with a Lunge's



nitrometer, or similar apparatus, in which case the three-way tap of the nitrometer is connected to the straight capillary tube of the pipette. Burettes are made by the same firm for use with the above pipettes, having a three-way tap at top and another lower down. Above the upper tap is a conical cup, into which may be placed the conical end of the pipette and the joint made air-tight by means of a short piece of flexible tubing. The three-way tap is for use with pipettes having straight capillary tubes.

Welsh Gold Mining.—In reference to the proposed formation of a Company for working Mr. W. Pritchard-Morgan's gold mine in North Wales, it may interest our readers to know that the gold in the ingot weighing 1 cwt. 33 lbs., exhibited at the recent Soirée of the Royal Society by Mr. Crookes, came from the Chidlaw lode in this mine, and that some of the richest specimens of auriferous quartz, blende, and other gold-bearing minerals exhibited at the same time were actually quarried by him from the same place. Mr. Crookes has been acquainted with these auriferous deposits for twenty-five years, and in October last he spent a fortnight in examining this particular shoot of gold, and in prospecting in the neighbourhood.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

French Technical Terms.—Would any reader kindly inform me the meaning of the following terms:—"*Pureté vivien*" (applied in the analysis of sugar-beets), and "*démariage*" (applied in agriculture)?—CHEMICUS.

CIVIL SERVICE COMMISSION.—Forthcoming Examination. Assistant to the Lecturers on Chemistry, &c., at the Royal Artillery College (25—30), 3rd July.
The date specified is the latest at which applications can be received. They must be made on Forms to be obtained with particulars from the Secretary, Civil Service Commission, London, S.W.

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THE CHEMICAL NEWS.

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EXPERIMENTS ON CARBON AT HIGH TEMPERATURES AND UNDER GREAT PRESSURES, AND IN CONTACT WITH OTHER SUBSTANCES.*

By the Hon. CHARLES A. PARSONS.

The primary object of these experiments was to obtain a dense form of carbon which should be more desirable than the ordinary carbon for use in arc lamps, and at the same time to obtain a material well suited for the formation of the burners of incandescent lamps.

There were a considerable number of experiments made in which the conditions were somewhat alike, and many were almost repetitions with slightly varied pressures and temperatures. They may, however, be divided into two distinct classes: the first in which a carbon rod surrounded by a fluid under great pressure is electrically heated by passing a large amount through it; the second in which the liquid is replaced by various substances, such as alumina, silica, lime, &c.

The arrangement of the experiment was as follows:—A massive cylindrical steel mould, of about 3 inches internal diameter and 6 inches high, was placed under a hydraulic press; the bottom of the mould was closed by a spigot and asbestos-rubber packing—similar to the gas-check in guns; the top was closed by a plunger similarly packed,—this packing was perfectly tight at all pressures. In the spigot is a centrally bored hole into which the bottom end of the carbon rod to be treated fits; the top end of the carbon rod is connected electrically to the mould by a copper cap, which also helps to support the carbon rod in a central position. The bottom block and spigot are insulated electrically from the mould by asbestos; and the leading wires from the dynamo being connected to the block and mould respectively, the current passes along the carbon rod in the interior of the mould.

The fluid is run in so as to cover the rod completely. The plunger is then free to exert its pressure on the liquid without injuring the carbon. The pressure in the mould is indicated by the gauge on the press.

Experiments. Class I.

Among the liquids tested were benzene, paraffin, treacle, chloride and bisulphide of carbon.

The pressures in the mould during the several experiments were maintained at from 5 to 15 tons per square inch; the initial size of the rod was in all cases ¼ inch, and the current from 100 to 300 ampères.

Results.—In some of these experiments a considerable quantity of gas was generated, and the press had to be slightly slacked back during the experiment to accommodate it and maintain the pressure constant.

In all cases there was a soft friable black deposit of considerable thickness on the carbon.

In no case was the specific gravity of the carbon rod increased by this process; there was no change in appearance of the fracture, excepting when chloride of carbon had been the fluid,—it was greyer in this case.

The rate of burning of samples placed in arc lamps was not diminished by the process. Various rates of deposition were tried, but with the same result, and the conclusion seems to be that under very high pressures—such as from 5 to 15 tons per square inch—the deposit of carbon by heat from hydrocarbons, chloride of carbon, bisulphide of carbon, treacle, &c., is of a sooty nature, and unlike the hard steel-grey deposit from the same liquids or their vapours at atmospheric or lower pressures.

Experiments. Class II.

In these experiments the asbestos-rubber packing was omitted, the plunger and spigot being an easy fit in the mould. A layer of coke powder under the plunger formed the top electrical connexion with the rod.

No. 1. Silver sand or silica was run around the carbon rod, and pressures of from 5 to 30 tons per square inch applied; the rod was usually about ¼ inch diameter, and currents up to 300 ampères passed.

Results.—The silica was melted to the form of a small hen's egg around the rod. When the current was increased to about 250 ampères the rod became altered to graphite, the greater the heat apparently the softer the graphite. There was no action between the silica and the carbon, the surface of the carbon remained black, and there were no hard particles in or on the carbon rod.

Other substances, such as an hydrated alumina and mixtures of alumina and silica, gave the same results.

The density of the carbon was considerably increased, in some cases from normal at 1·6 to 2·2 and 2·4: in these cases the carbon appeared very dense, much harder than the original carbon, and about as hard as the densest gas-retort carbon. No crystalline structure was visible.

The specimens were treated with solvents, and there appeared no indication of the surrounding substance having penetrated the substance of the rod; the carbon was undoubtedly consolidated by 30 per cent.

In some cases carbon in the form of soft crystals of graphite exuded from specimens that had been kept for some weeks; the material surrounding the rod was alumina saturated with oil.

No. 2. Pure hydrated alumina, carbonate and oxide of magnesia and lime, all rapidly destroyed the carbon rod, by combining with it, the hydrated alumina forming large volumes of gas of which it appeared to be a constituent. With the carbon, on account of the great diminution of bulk, no analysis was made; the gas issued from the mould explosively at from 10 to 12 tons per square inch. The alumina was found in a crystalline crust like sugar around where the rod had been. Hardness that of corundum, and semi-translucent.

No. 3. The following is the most interesting experiment of the series:—

On the bottom of the mould was a layer of slaked lime about ¼ inch thick, over this silver sand 2 inches, then another layer of lime of the same thickness as the former, finally a layer of coke-dust, and then the plunger. With a pressure of from 5 to 30 tons per square inch in the mould, currents from 200 to 300 ampères were passed through the carbon of from ¼ to $\frac{5}{16}$ diameter.

In from ten to thirty minutes the current was generally interrupted by the breaking or fusing of the rod, or by the action of the lime in dissolving it at the top or bottom. On opening the mould when it had cooled a little, the silica usually appeared to have melted to an egg-shaped mass, and mixed somewhat at the ends with the lime; the surface of the carbon appeared acted on, and sometimes pitted and crystalline in places; silica adhered to the surface, and beneath, when viewed under the microscope, appeared a globular cauliflower-like formation, of a yellowish colour, resembling some specimens of "bort." *

After several days' immersion in concentrated hydrofluoric acid, this formation remained partly adherent to the carbon; on the surface of the carbon was a layer or skin about 1-64th of an inch thick, of great hardness, on the outside grey, the fracture greyer than the carbon, but having a shining coke-like appearance under the microscope.

* A Paper] the Royal Society, June 14th, 1888.

* The bort-like powder is not acted on by hydrofluoric and nitric acids mixed.

The powder scraped off the surface of the rod has great hardness, and will cut rock crystal when applied with a piece of metal faster than emery powder. It has, under the microscope, the appearance of bort; the minute particles seem to cling together; they are not transparent as a rule, and though some such particles are found among them, it is not clear that such are hard.

When a piece of the skin has been rubbed against a diamond or other hard body the projecting or hard portions have a glossy coke-like appearance.

A piece of the skin will continue to scratch rock crystal for some time without losing its edge. It will scratch ruby, and when rubbed for some time against it will wear grooves or facets upon it. When a cut diamond is rubbed on the surface of the skin it will cut through it into the carbon beneath, making a black line or opening about $\frac{1}{4}$ inch long, the facet on the diamond—originally $\frac{1}{32}$ inch diameter—will have its corners evenly rounded, and its polished surface reduced to about one-half its original area; the appearance of the edges is as if they had been rubbed down by a nearly equally hard substance.

The subject of the last experiment is scarcely sufficiently investigated to warrant any definite conclusions.

The substance, in the several ways it has so far been tested, seems to possess a hardness of nearly if not quite the first quality; but on account of the minuteness of the particles which appear more or less cemented together, and are more cohesive before the action of acid, it is very difficult to determine this.

The mode of formation is not inconsistent with the conditions of pressure, temperature, moisture, lime, silica, and other substances which appear to have existed in the craters or spouts of the Cape Diamond Mines.

From the few experiments that have been made it appears that at pressures below 3 tons per square inch the deposit does not possess the same hardness, though somewhat similar in appearance.

What part the lime and silica play, whether the former only supplies moisture and oxygen which combine with the carbon, or whether the presence of lime is necessary to the action, is not clear.

We may, however, observe that so far it seems as if the lime and moisture combining with the carbon form a gas or liquid at great pressure, which combines with the silica, forming some compound of lime, silica, and carbon, or perhaps pure carbon only, of great hardness.

THE MINIMUM POINT OF CHANGE OF POTENTIAL OF A VOLTAIC COUPLE.*

By Dr. G. GORE, F.R.S.

In a previous communication on "The Effect of Chlorine on the Electromotive Force of a Voltaic Couple" (*Roy. Soc. Proc.*, May 3rd, 1888) I described a phenomenon which I now venture to term the "Minimum Point of Change of Potential of a Voltaic Couple." In that description a "thermo-electric pile" is mentioned as having been used for the purpose of balancing the electromotive force of the couple, whilst finding the minimum point of change." As very few persons possess a thermo-electric pile suitable for the purpose, I have devised and employed the following arrangement, by means of which the use of the pile may be dispensed with:—

Take a voltaic couple, composed of an unamalgamated strip, or stout wire of zinc or magnesium (the latter is usually the best), and a small sheet of platinum, immersed in distilled water; balance its electric potential through an ordinary galvanometer by that of a precisely similar couple composed of portions of the same specimens of the same metals, immersed the same moment as the other pair in a separate quantity of the same water; and gradually add to one of the two cells sufficiently small and known quantities of an adequately weak solution of known strength in a portion of the same water of the substance to be used, until the balance is upset, and take note of the proportions of the substance and of water then contained in that cell. It is more easy to successively dilute than to successively strengthen the solutions, and thus arrive at the "minimum point." The method is a little less accurate than the one in which the thermo-pile is employed.

By means of this method, using a couple composed of magnesium-platinum in distilled water, I have found the following "Minimum Points of Change of Voltaic Potential" in solutions of potassic chloride, potassic chlorate, hydrochloric acid, and chlorine. I selected these substances because they were representative ones, suitable to yield results for comparison, and because they gave extreme and intermediate magnitudes of the effect. The results are compared with those obtained with a Mg+Pt couple and the thermo-pile.

Potassic Chloride, KCl.

Solution at 18° C.; "minimum point" lay between 1 part in 3875 and 4650 parts of water; and by the aid of the thermo-pile, with the solution at 17° C., "minimum point" between 1 in 3875 and 4305.

Potassic Chlorate, $KClO_3$.

Solution at 19° C.; "minimum point" between 1 in 4650 and 5166; and with the pile, solution at 18° C., between 1 in 4920 and 5470.

Hydrochloric Acid, HCl.

Solution at 17° C.; "minimum point" between 1 in 516,666 and 664,285; and by the aid of the pile, solution at 19° C., between 1 in 516,666 and 574,074.

Chlorine, Cl.

Solution at 18° C.; "minimum point" between 1 in 15,656,500,000 and 19,565,210,000; and with the pile, solution at 12·5° C., between 1 in 17,000 millions and 17,612 millions.

These results show the great degree of delicacy of each method, and the extremely large difference of proportion of different substances required to upset the balance. The two methods agree.

By employing a great variety of dissolved substances I have found that nearly every such substance has a minimum proportion, below which it has no apparent effect upon the electromotive force of a MgPt or ZnPt couple in distilled water; and this proportion appears to be a constant number dependent only upon very simple conditions, viz., unchanging composition of the voltaic couple and liquid, a uniform temperature, and employing the same galvanometer. The apparently constant numbers thus obtained may probably be used as tests of the purity or of the uniformity of composition of dissolved substances.

The "minimum point" and degree of sensitiveness varies with—1st, the chemical composition of the liquid; 2nd, the kind of positive metal; 3rd, to a less degree with the kind of negative metal; 4th, the temperature at the surface of the positive metal, and at that of the negative one; and 5th, with the kind of galvanometer employed.

The order of the degree of sensitiveness or magnitude of the "minimum point" is manifestly related to that of degree of chemical energy of the liquid, and therefore also to the atomic and molecular weights of the dissolved substances, and to the ordinary chemical groups of halogens. With certain exceptions it is also distinctly related to the amounts of chemical heat. The greater the degree of free chemical energy of the dissolved substance, and the greater its action upon the positive metal, the smaller the proportion of it required to upset the balance. The proportion necessary for this purpose probably represents

* Read before the Royal Society, June 14, 1888.

a fixed amount of voltaic energy in all cases, viz., the amount necessary to overcome the mechanical inertia of the needle of the particular galvanometer employed.

As the "minimum point" of a chemically active substance dissolved in water is usually much altered by adding almost any soluble substance to the mixture, measurements of that point in a number of liquids at a given temperature, with the same voltaic pair and galvanometer, will probably throw some light upon the state of combination and degree of chemical freedom of substances dissolved in water.

ON THE ACTION OF PHOSPHORUS PENTACHLORIDE ON ACETANILIDE.

By ARTHUR MICHAEL.

THE investigations of Gerhardt* and Wallach† on the action of phosphorus pentachloride on anilides and alkyl amides have shown that the oxygen of the carbonyl is replaced by chlorine, but that these compounds are not very stable, and decompose into compounds having the general constitution R—CClNR and chlorhydric acid. Wallach, to whom we are principally indebted for the investigation of these interesting reactions, found that even the secondary products of the reaction are not stable in the heat, but pass over into basic substances free of chlorine. The investigation of the action of phosphorus pentachloride on the aromatic ethers of acetic acid led me to believe that an analogous reaction might be realised by the action of the pentachloride on anilides, and I made a few experiments with acetanilide in that direction, which, although they have not resulted in the synthesis of the anticipated class of substances, are not without interest. Forty-eight grms. of pentachloride (3 mols.) were brought into a flask connected with a condenser, cooled with ice, and ten grms. of powdered acetanilide (1 mol.) added. After the reaction that takes place in the cold, when, as Wallach has shown, the compound $CH_3—CClNC_6H_5$ is formed, the flask was allowed to stand at the ordinary temperature as long as chlorhydric acid came off, and the reaction was then completed by heating on a water-bath. The homogeneous mass—all the pentachloride was used up—was poured into water, when an oily mass remained undissolved that soon solidified. This substance was purified by crystallising from alcohol, and gave the following figures on analysis :—

0·2458 grm. substance gave 0·4258 grm. CO_2 and 0·0804 grm. H_2O.

0·2490 grm. substance gave 0·3525 grm. AgCl.

0·2734 grm. substance gave 0·3827 grm. AgCl.

	Theory for $C_8H_8Cl_2N_2$.	Found.		
C	47·29	47·24		
H	3·94	4·21		
Cl	34·97	—	34·94	34·64

The substance crystallises from alcohol in large white monoclinic prisms that melt undecomposed at 116·5°—117°. It sublimes slowly at 100°, forming small prisms with truncated end-faces. In water, cold and hot, it is insoluble, very soluble in warm, fairly in cold alcohol.

The substance has neutral properties, it being insoluble in acids as well as alkalies.

The action of pentachloride on acetanilide gives an entirely different result if, instead of heating on a water-bath, the mixture is allowed to remain in a moderately warm place for a long time. The mixture of pentachloride and anilide, in the same proportions as in the preceding experiment, was first cooled off on ice, and then allowed to stand at a temperature of about 35° for a week, when the greater part of the pentachloride was decomposed. It was noticed that after a number of days a yellow crystalline substance began to separate from the clear supernatant liquid. The contents of the flask were poured into water, and the insoluble residue purified by four crystallisations from alcohol.

I. 0·2621 grm. substance gave 0·5522 grm. CO_2 and 0·107 grm. H_2O.

II. 0·2482 grm. substance gave 0·5251 grm. CO_2 and 0·1029 grm. H_2O.

III. 0·2534 grm. substance gave 0·3172 grm. AgCl.

IV. 0·2015 grm. substance gave 0·2529 grm. AgCl.

	Theory for $C_{28}H_{36}Cl_7N_4$.	Found.			
		I.	II.	III.	IV.
C	57·32	57·47	57·54		
H	4·56	4·54	4·60		
Cl . ..	31·00	—	—	30·96	31·03

The compound forms concentric groups of long lemon-coloured needles that melt at 227° to 229°, but begin to darken at 210°. It is insoluble in hot water, benzene, and ether, moderately soluble in hot chloroform, readily in glacial acetic acid and hot alcohol, pretty soluble in cold alcohol. Like the preceding compound, it is insoluble in acids and alkalies.

It would be useless to speculate on the constitution of these substances until a more detailed investigation of their behaviour towards reagents has been made. The research will be continued in this direction, and it is also proposed to examine other anilides, as well as alkyl amides, in a similar manner.—*American Chemical Journal*, Vol. ix., No. 3.

* *Ann. Ch. et Phys.* [3], liii., 302.

† *Annalen der Chemie*, clxxxiv., 1 ; ccxiv., 193, 257

RECENT INVESTIGATIONS ON THE FULMINATES.

By H. N. WARREN, Research Analyst.

THE exact nature or formulæ of fulminic acid and its compounds, owing to their extreme unstableness, even to the present time, is, comparatively speaking, little known. The following experiments lately performed with these bodies, although possessed of scientific interest only, offer further contributions to our knowledge of them.

On account of the extremely dangerous nature of the fulminates necessitating the use of so small a quantity when examining their different reactions, some slight doubt naturally arises as to their exact nature. The salt used to conduct the experiments with was argentic fulminate (ordinarily fulminating silver). This being dissolved in hot water, and digested with copper filings, was transformed into cupric fulminate ; the green salt obtained was dissolved in water and introduced into a tube open at either end, one extremity being closed by means of a porous diaphragm. The salt was reduced by means of nascent hydrogen, according to the usual method, namely, by connecting the same with a small Daniell's cell, the inside of the tube being provided with a platinum electrode connected with the negative end of the battery. In the course of a few hours the whole of the copper had become reduced to the metallic form, and firmly attached to the platinum plate.

The solution obtained, being thus freed from copper, was next examined, and was found to contain—besides large quantities of hydrocyanic acid and ammonia—distinct quantities of fulminic acid, evidently existing as ammonium fulminate. This was obtained and examined as fulminating silver, by digesting the same with argentic carbonate. In every instance an explosive fulminate was re-formed, corresponding to the normal fulminate.

In the next experiment cupro-ammonium fulminate was obtained by the addition of an excess of ammonia to a

solution of cupric fulminate. The deep blue crystals thus formed were, after being dried by suspending them over sulphuric acid, decomposed by dry sulphuretted hydrogen. The product consisted, however, chiefly of copper sulphide, with urea and ammonium sulphocyanide.

Further, an attempt was made to combine fulminic acid with the element silicon, by passing a stream of dry silicon fluoride over argentic fulminate, kept moist by means of petroleum. Large quantities of argentic fluoride were at once formed, and the escaping gas—when collected and examined by introducing a light to the same—exploded with considerable violence.

Although the results obtained from several experiments performed by the same method agree with each other identically, it still remains an open question whether such a compound as silicon fulminate does in reality exist.

Chlorine, iodine, and bromine were also used, but chiefly gave rise to the substance known as chloropicrin and other bodies of an allied formula.

Experiments were also performed with the view of obtaining an ethyl compound, but these require further investigation before speaking definitely of them.

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INVESTIGATIONS ON THE OXIDATION OF SEWAGE.*

By J. H. LONG.

Something over a year ago I began a series of experiments for the Illinois State Board of Health, intended to show the rate of oxidation or destruction of sewage in a canal flowing west from the city of Chicago, and discharging finally into the Illinois river.

The peculiar situation of Chicago and its system of drainage dependent on this make such tests unusually interesting, and I wish, in the following, to present some of the results obtained in the work.

Only a few miles south and west of the city is found the low watershed separating the basin of Lake Michigan from that of the Mississippi. On the Chicago side of this "divide" is the Chicago river, mostly within the city limits, which serves as a harbour for shipping, and likewise as a receptacle for the greater part of the sewage from a population of about 800,000.

Many years ago the Illinois and Michigan Canal was constructed, connecting Lake Michigan through the river with the Illinois river at a point about 48 miles south-west of the city. This canal is supplied with water by pumps located at Bridgeport, within the city limits, five miles from the lake, which at present lift about 50,000 cubic feet per minute and discharge it toward the west.

The canal, then, at its eastern end, is fed by dilute sewage, and it is the changes in this that I have to explain.

This dilute sewage is made up chiefly of three elements:—

1. Of the water of Lake Michigan. This water contains in parts per million 136 parts of total solids, and furnishes of free ammonia from 0 to 0·01 part per million, and of albumenoid ammonia 0·070 part per million. In oxidation by the Kubel process, about one part per million of oxygen is required.

2. Of about 70,000,000 gallons per day of sewage proper. We have no accurate data showing the average composition of this as it leaves the sewers, but samples taken near the mouths of some of these showed large amounts of free ammonia, indicating an advanced stage of decomposition.

3. Of about 7,000,000 gallons daily of sewage from the large stockyards south of the city. The character of this has been investigated. In samples analysed last autumn I found the solid matter to amount to about 9200 parts per million, with between 3000 and 4000 parts of organic matter. Samples were taken every hour through the twenty-four, mixed and analysed, after dilution with pure water. In this way I found for one day, October 29th, in parts per million:—

Free ammonia	42
Albumenoid ammonia	6·4
Oxygen consumed.	208

The results obtained on other days averaged about the same.

Collection and Analysis of Samples.

The waters were taken in gallon jugs on the same day at the several stations, and sent to me by express. They were examined as soon as possible after their receipt.

After necessary dilution with pure water I determined free and albumenoid ammonia, taking precautions to make these experiments as accurate and uniform as practicable. I also found the consumption of oxygen by the Kubel process. Full details of the several methods, as followed, were given in my reports to the State Board of Health last winter, which, however, are not yet published.

The Water at Bridgeport.

Ten analyses were made of the water just as it reached the pumps. The first tests were made on water taken on June 26th, 1886, and the last on water taken on August 28th, with results as follows:—

	In 1,000,000 Parts.		
	Free Ammonia.	Alb. Ammonia.	Oxygen consumed.
June 26	2·6	0·64	12·0
July 3	2·7	0·52	6·8
,, 10	4·2	0·62	16·8
,, 17	25·0	1·50	22·4
,, 24	5·5	0·37	12·6
,, 31	23·0	1·76	23·2
Aug. 7	26·0	1·50	16·8
,, 14	29·0	1·64	32·0
,, 21	27·2	1·50	28·0
,, 28	29·2	1·90	35·2
Mean..	17·44	1·195	20·58

The smaller amounts of contamination in the first tests can be accounted for by the fact of a high lake level, in consequence of which the sewage outflow from the stockyards' sewer and other sewers was at times much retarded, and a comparatively clean water reached the pumps from the lake.

The Water at Lockport.

After leaving the pumps, the water flows along the level to Lockport, 29 miles below, requiring about a day for its passage. The canal water receives no additions between the two places, that is, it is not diluted by any other stream or feeder. The rainfall during the summer

The tests gave:—

	In 1,000,000 Parts.		
	Free Ammonia.	Alb. Ammonia.	Oxygen consumed.
June 26	2·8	0·56	11·36
July 3	2·4	0·42	7·2
,, 10	—	—	—
,, 17	10·2	0·72	12·8
,, 24	9·2	0·47	14·8
,, 31	11·0	0·72	10·7
Aug. 7	12·0	0·48	9·6
,, 14	15·2	0·88	9·76
,, 21	15·0	0·84	10·8
,, 28	13·0	0·88	12·4
Sept. 4	11·5	0·72	13·6
Mean..	10·23	0·669	11·30

* *American Chemical Journal*, Vol. x., No. 1.

of 1886 was unusually small; in fact, the lowest in 15 years. Dilution from this source can be left quite out of consideration, and owing to the frequent passage of propellers and other boats, no very great change in the character of the water by sedimentation could take place.

The Water at Joliet.

After passing Lockport, the water descends to Joliet through four locks, and falls over a dam seven feet in height, to point of collection. There is a fall of 58·2 feet in a distance of four miles, and no dilution takes place on the way.

The tests gave results as follows:—

	In 1,000,000 Parts.		
	Free Ammonia.	Alb Ammonia.	Oxygen consumed.
June 26	1·7	0·46	7·36
July 3	1·8	0·46	9·76
„ 10	2·4	0·56	9·20
„ 17	13·0	0·44	14·50
„ 24	—	—	—
„ 31	9·2	0·44	5·68
Aug. 7	7·5	0·42	5·84
„ 14	9·8	0·46	5·76
„ 21	9·0	0·112	0·520
„ 28	8·0	0·32	6·80
Mean..	6·93	0·408	7·79

Although there are certain irregularities in the above table which cannot now be explained, a general decrease of organic matter is plainly shown; and it will also be noticed that the percentage of loss per mile is much greater between Joliet and Lockport than between the latter and Bridgeport. This is undoubtedly due to the more perfect aëration of the water secured by the passage through the locks and over the dam.

The loss per mile is this, expressed in terms of amount at upper station:—

	Free Am.	Alb. Am.	Oxygen used.
Bridgeport to Lockport .	1·44 p.c.	1·52 p.c.	1·55 p.c.
Lockport to Joliet.. ..	8·06 „	9·75 „	7·76 „

Thus the loss of free ammonia per mile between Bridgeport and Lockport is 1·44 per cent of the amount at Bridgeport, while the loss between Lockport and Joliet is 8·06 per cent of the amount at Lockport.

Through a good part of its course the canal flows parallel to the Des Plaines river, which, 48 miles below Bridgeport, unites with the Kankakee to form the Illinois, into which also a large portion of the canal water is diverted.

The next tests were made at Ottawa, 48 miles below Joliet and 73 feet lower. The Fox river joins the Illinois at this point, so that the canal water becomes very much diluted. From surveys and measurements made recently it has been estimated by Mr. L. E. Cooley, of the Chicago Drainage and Water Supply Commission, that at the period under investigation—the summer of 1886—43 per cent of the water at this point came from the canal, and the rest from the streams named.

The chemical tests gave:—

	In 1,000,000 Parts.		
	Free Ammonia.	Alb. Ammonia.	Oxygen consumed.
June 26	0·50	0·23	7·05
July 3	0·104	0·21	0·576
„ 10	0·22	0·164	4·96
„ 17	0·56	0·252	6·54
„ 24	—	—	—
„ 31	0·49	0·250	6·00
Aug. 7	0·52	0·32	6·40
„ 14	0·30	0·144	4·80
„ 21	—	—	—
„ 28	0·36	0·33	3·12
Mean..	0·382	0·237	5·57

These figures show a remarkable decrease in the free ammonia, the loss amounting to 94·5 per cent of the quantity at Joliet. This is partly accounted for by the large dilution, as 57 per cent of the water here comes from sources other than the canal, as explained; but, unfortunately, it is not possible to express numerically the effect of this dilution, as we do not know the exact composition of diluting waters.

At first sight it would appear that, taking into consideration the amount of dilution, instead of there being a loss of albumenoid ammonia and oxygen consumed, there is a gain in this flow of 48 miles. This apparent anomaly can be explained, I think, without great difficulty.

The streams feeding the Illinois flow through a rich soil and partly swampy regions, where relatively large quantities of organic matter are taken up. The Sangamon river in this State is in some respects analogous to the Kankakee. I analysed a sample of its water, taken at Decatur, in the summer of 1885, and found it very highly contaminated with vegetable matter, partly suspended and partly in solution. The organic matter dissolved amounted to about 40 parts per 1,000,000, and other tests gave in parts per 1,000,000:—

Free ammonia	0·013
Alb. ammonia	0·170

I have no doubt that the river water at Ottawa, free from sewage, would show as large an amount of nitrogenous matter as these figures indicate.

It must also be remembered that the sewage of several towns enters the river above Ottawa. Joliet, which is sewered pretty completely, has a population of 15,000, while the other sewered places may have 5000 more. It is fair, then, to believe that a moderate change in the amount of organic matter has occurred between the two stations. The probability of such change is shown by the determinations made at Peoria, 78 miles below Ottawa, but at a lower level of only 15·5 feet.

There are no tributaries of any consequence between these cities. The proportion of canal water is decreased only from 43 per cent to 39 per cent, while sewage from several important towns is taken up.

It may also be added that the total flow at Peoria amounted to about 125,000 cubic feet per minute at the time of the tests, while about 22 days were required for the descent from Ottawa.

The tests gave:—

	In 1,000,000 Parts.		
	Free Ammonia.	Alb. Ammonia.	Oxygen consumed.
June 26	0·036	0·150	5·04
July 3	—	—	—
„ 10	0·084	0·150	5·04
„ 17	—	—	—
„ 24	—	—	—
„ 31	0·0048	0·196	4·64
Aug. 7	0·0072	0·210	6·80
„ 14	0·042	0·190	4·72
„ 21	0·066	0·212	4·88
.. .. ..	0·009	0·206	2·80
Mean..	0·0355	0·1877	4·85

Unfortunately, there are three breaks in this table due to the neglect of the persons expected to forward the water. The tests carried out showed, as at Ottawa, a marked loss of free ammonia, which must be explained chiefly by oxidation. There is likewise a perceptible diminution in the amount of oxygen consumed and in the albumenoid ammonia, even after the dilution is taken into consideration.

It is plain that in this long stretch of 78 miles with a fall of only 15 feet the water must be in many places practically stagnant, and we know that under such circumstances oxidation of organic matter is necessarily slow. The conversion of ammonia into nitrates is

apparently much more rapid. It is possibly true that the residual organic matter, represented by the oxygen consumption and albumenoid ammonia, is of a relatively stable type, capable of resisting complete change for a long period, but which may be broken up with comparative ease by the reagents of the laboratory processes. Many of the vegetable matters, finding their way into these waters, are of that nature, as numerous experiments have shown.

It must also be borne in mind, as mentioned above, that a certain amount of sewage is discharged into this portion of the river, and taking all these points into consideration, it is fair to conclude that destruction of organic matter is going on here at a moderate rate, but less rapidly than above.

It would be interesting to know the condition of affairs in the stream between Peoria and its junction with the Mississippi, a distance of some 200 miles. An investigation of this nature is contemplated for the near future.

The above tests show in a fair and unmistakable way the general fact of the gradual purification of a highly contaminated water by what may be broadly termed oxidation. In the upper part of the course sedimentation cannot be called into account for much of this change, as the water undergoes frequent agitation by passing boats. In the lower part of the course this disturbance is less frequent, but at the same time the matter which could be lost by sedimentation is less abundant.

I am therefore led to attach considerable importance to these investigations, as showing pretty fully the rate at which a city's sewage is destroyed under certain conditions of temperature, dilution, and velocity of flow. In most similar investigations these important data are given imperfectly or not at all, so that to draw a legitimate conclusion is almost impossible.

Oxidation in Winter.

It is generally admitted that destruction of sewage is less rapid in winter than in summer, although direct chemical experiments bearing on that point are very few.

During last winter the above investigations were continued so as to show as nearly as possible just what the effect of the cold really is. The waters were taken at the same places by the same observers and examined in the same way. The results of these examinations are given in the accompanying table—the results expressed in parts per 1,000,000.

From	When taken.	Free Ammonia.	Albumenoid Ammonia.	Oxygen consumed.
Bridgeport ..	Dec. 18	17·60	4·80	28·8
,, ..	Jan. 18	6·60	3·50	16·0
,, ..	,, 29	5·90	3·80	22·4
,, ..	Feb. 3	10·60	3·70	32·8
Lockport. ..	Dec. 6	3·70	0·56	17·6
,, ..	Jan. 3	9·20	3·90	21·6
Joliet	Dec. 7	11·00	0·60	16·8
,, ...	,, 13	13·00	1·80	19·2
,, ...	,, 20	13·20	3·30	21·6
,, ...	,, 27	18·40	4·90	24·8
,, ...	Jan. 1	11·60	3·72	19·6
,, ...	,, 8	8·40	4·20	18·4
,, ...	,, 15	5·40	3·00	10·0
,, ...	,, 22	3·24	1·76	14·4
,, ...	,, 29	3·20	1·54	10·0
,, ...	Feb. 4	3·80	2·22	19·2
Ottawa	Dec. 9	1·52	0·54	10·4
,, ...	,, 13	5·74	2·60	15·2
,, ...	,, 22	6·80	1·20	11·2
,, ...	,, 28	0·96	2·92	*60·0
,, ...	Jan. 4	8·20	2·70	10·8
,, ...	,, 8	2·20	2·80	*44·0
,, ...	,, 22	2·60	0·30	6·8
,, ...	,, 29	0·36	0·32	†11·2
,, ...	Feb. 5	3·70	0·38	9·2
,, ...	,, 12	3·20	0·46	10·8
Peoria	Jan. 15	1·26	0·25	4·4
,, ...	,, 22	3·60	0·68	7·36
,, ...	,, 29	0·52	0·36	7·60
,, ...	Feb. 2	0·90	0·36	8·80
,, ...	,, 7	0·72	0·34	7·90

In this table there are many perplexing irregularities, some of which can be explained, while for others the data are lacking.

On the 7th of December, owing to an accident, pumping was stopped at Bridgeport, and did not begin again until December 27th. During this time the flow under the ice through the canal amounted to about 15,000 cubic feet per minute by gravity, while the flow in the small rivers below was likewise lessened. After December 27th the pumps forced about 50,000 cubic feet per minute through the winter.

In January there is shown a decrease in the free ammonia with an increased amount of albumenoid ammonia and oxygen consumed at Bridgeport and Joliet, as compared with the summer rate, while at Ottawa and Peoria all these factors are increased. After the close of navigation sedimentation plays an important part in the still water. For this reason purification appears more rapid than is actually the case.

Near the source of contamination we can understand that free ammonia is not so quickly formed, because of the low temperature; and for the same reason, when once formed, it is not so readily oxidised at points further down in the stream.

The effect of the stoppage of the pumps is shown in the albumenoid ammonia as late as January 8th at Ottawa. After this date, between Ottawa and Peoria there seems to be no change in the organic nitrogenous matter, the amount at the latter place being about twice as great as during the summer.

The waters collected at Peoria during the summer were without odour, while through the winter it was frequently quite marked. It is said to be very noticeable at holes broken in the ice, and if the filth left above by deposition reached here it would be much worse.

This state of the water can be partly accounted for by the diminished flow from some of the streams feeding the Illinois, but the chief factor is undoubtedly the low temperature. A coating of ice excludes the air, and thus prevents direct oxidation when this is possible. A more important result of lower temperature is found in the diminished activity of bacterial ferments. These are probably the chief agents in the decomposition of organic filth, and their efficiency is greatest at moderate temperatures.

The above experiments, while not as complete as could be desired, show several important points. Even under the unfavourable conditions in the canal and river, it is seen that sewage is pretty rapidly decomposed in summer. With a greater velocity of the flowing water this change would undoubtedly be much more complete.

The slow rate of winter change is clearly shown. These results suggest another very interesting inquiry, viz., At what rate is *rapidly moving* sewage oxidised in winter? An answer to this, with statement of all conditions, would have a great practical value.

Action of Calcium Carbonate upon Cadmium Chloride, Bromide, and Iodide.—A. de Schulten.—With cadmium chloride the product formed is a compound of cadmium hydroxide and of the chloride of the same metal. Or it may be regarded as a cadmium hydrochlorate or a chlorhydrine. With cadmium bromide the result is crystals of a basic bromide. With cadmium iodide no precipitate is obtained.—*Comptes Rendus*, Vol. cvi., No. 24.

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* Very unusual colour and odour.

† This sample was taken on January 29, but not forwarded until a week later.

PROCEEDINGS OF SOCIETIES.

ROYAL SOCIETY OF CANADA.

THE Royal Society of Canada met at Ottawa, May 22nd to 25th, under the presidency of GEORGE LAWSON, M.A., Ph.D., LL.D., F.I.C., Professor of Chemistry, Dalhousie College, Halifax.

Fifty-six papers were read in the several sections, viz.:—I. Littérature Française, &c., fourteen; II. English Literature and History, twelve; III. Mathematical, Physical, and Chemical Sciences, nine; IV. Geological and Biological Sciences, twenty-one.

The President's Address referred specially to the importance of systematic tidal and current observations in Dominion waters, the scientific federation of the Empire, the International Geological Congress, the formation of a scientific library, and the scientific and literary work of the Members during the past year, a summary of which was given.

A Farewell Address was presented to His Excellency Lord Lansdowne, the Governor General, and the Marquis of Lorne was requested to represent the Society at the approaching eight-hundredth anniversary of the University of Bologna.

The following papers of interest to chemists were read:—

"*A Table of the Cubical Expansions of Solids.*" By Prof. J. G. MACGREGOR, M.A., D.Sc.

This paper contained a collection of the constants determining the thermal expansion of all the more important and interesting solids, with reference to the scientific memoirs from which they have been derived. These constants are the values of a, b, c, in the equation:—

$$V_t = V_0 (1 + at + bt^2 + ct^3)$$

which has been found capable of expressing the volume (V_t) of a body, at a temperature t, in terms of its volume (V_0) at 0° C., and of t. These constants being known, the mean coefficient of thermal expansion for any range of temperature within the temperature limits of the experiments by which the constants were determined, and the true coefficient at any temperature within the same limits, may be found without difficulty. Similar tables, formerly published, such as that of Prof. Clarke in his "Constants of Nature" (published by the Smithsonian Institution), give merely the values of the mean coefficients for given temperature ranges, thus embodying only a small portion of our knowledge of the expansion of solids.

"*The Foundations of Chemistry.*" By T. STERRY HUNT, LL.D., F.R.S.

"*The Classification and Nomenclature of Metalline Species.*" By T. STERRY HUNT, LL.D., F.R.S.

The author recalls his essay on "A Natural System in Mineralogy," presented in 1885, and published in Volume III. of the *Transactions of the Royal Society of Canada*, wherein he discussed the grounds and principles of a true natural system of Classification, and exemplified them by an extended study of the order of Silicates. It was then proposed to divide the mineral kingdom, for natural historical purposes, into four classes, including respectively the metalline, the oxidised, the haloid, and the pyricaustate or combustible species, of which the first, third, and fourth classes included only one order each, the second embracing seventeen orders. Adopting a Latin terminology, the first class becomes the METALLACEÆ, including the order of the METALLATES, which are divided into two sub-orders, the *Metallometallinea* and the *Spathometallinea*, based on the fundamental difference recognised by all naturalists between the group of the Glances and that of the Blendes. The author then proceeds to show the reason for including in the same order with these the group of the pyrites and the native metals, and arranges all these in nine tribes, based alike on chemical and on physical grounds.

Preparatory to this, however, the relations between hardness and specific gravity on the one hand and chemical equivalent on the other are next discussed, it being maintained that these physical characters vary with the condensation of the species, or, in other words, are functions of the integral or so-called molecular weight, which is at the same time the density of the species; that of hydrogen gas at 100 being unity. The weight of a given volume of this being known, that of the same volume of any other species, whether gaseous, liquid, or solid, is truly its equivalent weight. It is then shown that hydrogen gas at standard temperature and pressure being H 2 = 20, water vapour, H_2O, is 17·96; and liquid water 1192 (H_2O) = 21408, or in round numbers 21400, which, being that of a body whose specific gravity is assumed as unity, enables us to calculate the integral or equivalent weight of all species compared with it. It follows that the integral weights of solid and liquid species are very elevated, and that these are highly condensed on polymene bodies whose coefficient of condensation is determined by comparing their empirical combining weight deduced from chemical analysis with that calculated from their specific gravity, water being unity. The value got by dividing this empirical weight by the specific gravity—$p \div d = v$, or the so-called atomic volume, is the reciprocal of the coefficient of condensation, and, as long since pointed out by the author, the hardness and chemical indifference of related species are inversely as the value of v. In calculating this value, as already shown in 1885, the unit for p in metalline species is for convenience made the mean quantivalent weight; that is to say, it is the number got by dividing the empirical weight as deduced from the chemical formula by the sum of the equivalents therein represented, so that marcasite $FeS_2 = 120$, we divide by six and find $p = 20$, and for stibnite, $Sb_2S_3 = 336$, we divide by ten and find $p = 33·6$.

Order Metallates.

Sub-order A.—METALLOMETALLINEA.
- Tribe 1. *Metalloidæ* (various metals and alloys).
- Tribe 2. *Galenoideæ* (divided into three sub-tribes).
  - *a*. Thiogalenoideæ, gen. Thionites, Thiophyllites.
  - *b*. Selenogalenoideæ, gen. Eucairites.
  - *c*. Tellurogalenoideæ, gen. Tellurites, Tellurophyllites.
- Tribe 3. Bournonoideæ, gen. Bournonites, Empleitites.
- Tribe 4. Leucopyritoideæ, gen. Leucopyrites, Algoodonites.
- Tribe 5. *Arsenopyritoideæ*, gen. Arsenopyrites.
- Tribe 6. *Pyritoideæ*, gen. Pyrites, Pyritinus.

Sub-order B.—SPATHOMETALLINEA.
- Tribe 7. *Spathometalloideæ* (sulphur, selenium, phosphorus.
- Tribe 8. *Sphaleroideæ*, gen. Sphalerites, Sandaraca.
- Tribe 9. *Proustoideæ*, gen. Pyrargyrites, Termantites.

The Metalloideæ, including alike the native metals and those artificially got, present great differences of hardness and density, as well as in the value of v and in other characters, and must be grouped in several genera or subgenera. The Galenoideæ are conveniently divided into three sub-tribes of sulphides, selenides, and tellurides. The first or Thiogalenoideæ ($H = 2—3 : v = 7—8$) includes the typical genus Thionites, embracing the native sulphides of silver, lead, and copper, together with metacinnabar, stibnite, and bismuthite. ($H = 2—3 : v = 7—8$) includes the typical genus Thionites. The second, or Selenogalenoideæ, ($H = 2—3 : v = 8—9·5$), embracing the various selenides of silver, lead, copper, mercury, &c., of which encairite may be taken as a type. The third, or Tellurogalenoideæ, includes the genus *Tellurites*, comprising the tellurides of silver, gold, lead, mercury, bismuth, and nickel—

($H = 2·5—3·5 : v = 9·5—10·5$).

The soft flexible foliated sulphides, like sternbergite, argyropyrite, firesite, argentopyrite, and molybdenite, may constitute a genus.

Thiophyllites and tetradymite and nuggagite belong to another genus, *Tellurophyllites*.

The tribe Bournonoideæ includes the large genus *Bournonites* (H = 2—3·5 : v = 7·5—8), consisting of double sulphides of antimony with lead, silver, and copper, of which bournonite is a familiar example. The species of this genus present instructive examples of progressive series, especially those represented by $Sb_2S_3 \cdot n PbS$, in which n has values of 1, 2, 3, 4, 5, 6, and in a related species, of 12. The large group of double sulphides of bismuth, having similar values for H and v, of which empleitite may be taken as an example, constitutes the genus *Empleitites*.

The tribe Leucopyritoideæ, embracing various arsenides and antimonides, includes the genus *Leucopyrites*—

(H = 5—6 : v = 4·5—5·5),

made up of arsenides of iron, nickel, and cobalt, of which leucopyrite and smaltite are types, while the antimonial species breithauptite is closely related. The arsenides of copper, with less hardness and a higher value of v, will form another genus *Algodonites*, near to which is the antimonide of copper, horsfordite, and the antimonial silver, dyscrasite.

The Arsenopyritoideæ include the genus *Arsenopyrites* (H = 5—6 : v = 4·5—5·5), embracing the double sulphides of arsenic, with iron, cobalt, nickel, of which mispickel or arsenopyrite is a type. Closely related thereto are double sulphides, including antimony and bismuth, of which ullmannite, corynite, alloclasite, and gmuanite are examples.

The Pyritoideæ include two principal genera—*Pyrites* (H = 5·5—6·5 : v = 4—4·5), comprising sulphides of iron, cobalt, nickel, copper, chromium, and ruthenium; and *Pyritinus* (H = 3·5—4·0 : v = 4·7—5·5), also of sulphides of iron, nickel, copper, with manganese and tin.

In the Spathometalloideæ are comprised the various forms of sulphur, selenium, and phosphorus. The Sphaleroideæ include the genus *Sphalerites*—

(H = 2·5—4·0 : v = 6—7),

embracing sphalerite, wurtzite, greenockite, hauerite, oldhamite, and cinnabar. Here also probably belongs the red antimonic sulphide. The soft arsenical sulphides, realgar and orpiment, may perhaps form a distinct genus *Sandaraca*, to which cinnabar seems nearly related. The Proustoideæ include the genus *Pyrargyrites*—

(H = 2—3 : v = 8—9),

in which we place both arsenical and antimonial red silver ores—proustite, pyrargyrite, miargyrite, polybasite, &c. In this tribe also is placed *Tennantites*—

(H = 3·5—4·5 : v = 6·5—7·5),

including the various species of fahlerz, with bismite, dufrenoysite, livingstonite, &c.

Sphalerites	zinceus vulgaris	Sphalerite
,,	zinceus hexagonus	Wurtzite
,,	cadmeus	Greenockite
,,	ferrozinceus	Christophite
,,	manganeus	Panerite
,,	calcareus	Oldhamite
Pyrites	cubicus	Pyrite
,,	prismaticus	Marcasite
,,	cobalteus	Linnaeite
,,	niccolocobalteus	Seigenite
,,	cuprocobalteus	Carrollite
,,	rutheneus	Lawrite
Pyritinus	magneticus	Pyrrhotite
,,	ferrosus	Troilite
,,	manganosus	Alabandite
,,	cupreus	Chalcopyrite
,,	subcupreus	Cubanite
,,	supercupreus	Barnhardtite
,,	niccolosus	Millerite
,,	niccoloferrosus	Pentlandite
,,	subniccolosus	Polydmite
,,	stannorus	Stannipyrite

The hardness (H) and the value of v have here been given approximately. The paper presented includes all the species of this order, tables giving the chemical formulæ, crystalline forms, hardness, specific gravity, and the calculated value of p and v, besides a binomial Latin nomenclature, of which examples are here given from three genera.

"*Notes on Nova Scotia Gold Mines.*" By E. Gilpin, Jun., M.A., F.G.S.

The writer describes briefly the conditions under which the auriferous veins of Nova Scotia occur. The filling of the veins formed by the process of folding the strata have undergone was apparently continuous and contemporaneous. The relation of the granites intimately connected with the auriferous strata has apparently not influenced their value. The "pay streaks," or richest zones of the veins, are described, as well as the "low grade" ores. Reference is made to the question of lower or second pay streaks, and the local conditions of accumulation of gold from the associated beds of slate instanced as differing from the opportunities for repeated pay streaks in true or cross-country veins.

NOTICES OF BOOKS.

Twelfth Annual Report of Her Majesty's Inspectors of Explosives: being their Annual Report for the Year 1877. London: Her Majesty's Stationery Office.

The General Law on Explosives has received, during the past year, a very necessary amendment. Heretofore picric acid, its salts, and mixtures containing such acid or salts have been held as explosives, and have come within the purview of the Inspectors only when they were manufactured for military, engineering, or pyrotechnical purposes. If made for the use of the painter, dyer, or colour manufacturer they were exempt from control, though, of course, no less dangerous than if prepared with any other object. It is now considered as an explosive and dealt with accordingly, except wholly in solution, or kept in some separate locality where it cannot under any circumstances come in contact with any substance capable of forming an explosive mixture or compound, or with any detonator, or with fire.

The Inspectors consider that the weak point in the Explosives Act is its careless administration by local authorities, though even in this respect there has been a decided improvement during the last few years.

The total number of factories under the Act is 108, though 105 only are in actual use.

Certain new explosives have been submitted for examination, viz., roburite, amide-powder, Borland's powder, carbo-dynamite, and victorite. All these were passed except the last, as also "Forti's explosive," which stood over from the previous year. "Quick-firing ammunition" is licensed only for Imperial service.

Cases of the illegal manufacture of fireworks are still brought to light from time to time, chiefly in consequence of accidents.

Chemists still compound "coloured fires" on their premises. It is noted that an offender of this kind in Edinburgh was fined only half-a-crown. Blasting cartridges are now less frequently made in private houses. It is very gratifying to learn that the workpeople in the factories are beginning to feel the value of the official regulations.

Prosecutions have been instituted only in two cases. Temporary seizures were made in seven cases, but the articles were returned on removal of the cause of complaint, along with an undertaking for their future evidence. During the year sixty-three accidents have occurred, involving eight deaths and eighteen cases of personal injury.

The total number of magazines is now 347, being a decrease of seven since 1886. A dynamite magazine near Burrow-in-Furness was broken into by thieves, a box opened and a quantity stolen, the rest being scattered about. There was no reason to suspect political motives. In two instances only have proceedings been found necessary. At a store in Ayrshire an officer of the Local Authority found five young mice in a packet of dynamite!

Spilling loose gunpowder in and about a store containing 400 lbs. of gunpowder, near Birmingham, led to an explosion in which four persons were killed, four more injured, and considerable damage was done to property. It is satisfactory to learn that several attempts at the illegal importation of explosives have been detected and frustrated.

The total number of accidents in factories, magazines, and stores has been 130, involving 43 deaths and injuries to 105 persons.

The impression left upon the mind, after a careful examination of this bulky report, is that the Inspectors do fully all that can be expected, unless they were more efficiently supported not merely by the local authorities, but by public sentiment.

Soaps and Candles. Edited by JAMES CAMERON, F.I.C. London: J. and A. Churchill.

THIS work forms one of the series of "Technological Handbooks" issued by Messrs. Churchill. There is no one who can be regarded as the author, the editor informing us in his Preface that the articles in Cooley's "Cyclopædia" have been added to from various scattered sources. He also expresses his obligations to Mr. L. Field, of Lambeth, and to Messrs. Cook, of the East London Soap Works.

Details of many analytical processes have been omitted as probably known to the student,—a very judicious step in a treatise which undertakes to discuss two such important arts as soap- and candle-making in less than 300 pages.

The first chapter, extending to 16 pages, is devoted to the definition, history, and properties of soap,—a subject, perhaps, scarcely in its right place in a technical treatise. What we may call the practical part of the work begins with a notice of the materials. The reader is, however, referred for details to a companion volume on "Oils and Varnishes."

"Recovered grease" from the waste waters of the woollen works cannot be pronounced fit for the manufacture of soaps, as it is never entirely freed from promiscuous dirt, not to speak of the unsaponifiable oils. It is much more in its right place as a material for the production of oil-gas.

Under "Sunflower-seed" we meet with the interesting remark, from the pen of Mr. Leopold Field, that "the *perfect* soap has yet to be made, and it will probably be made from sunflower oil." We have often wondered why the sunflower is not cultivated in this country on a commercial scale. It is quite a mistake to say that our climate is not sunny enough, since the plant owes its name not to its especial craving for sunshine, but to its resemblance to images of the sun as drawn by barbarous nations in their temples. But we should submit that the ideal soap, the soap of the future, will be an artificial bile, equal to natural ox-gall in its detergent and at the same time non-corrosive action, but free from its disagreeable odour. Will none of the great synthesists of the day take up this problem?

Mr. L. Field, in his Report of the Imperial Exhibition of 1886, here quoted, expresses the opinion that the delicacy and persistency of the scents of the French toilet soaps is in some measure due to the fact that French toilet-soap makers use bleached palm oil much more than their English rivals. For contact with the human body soaps from the vegetable oils are safer than those obtained from animal fats, which are always liable to be accompanied by traces of putrescent animal matter.

In speaking of the alkalies the author does not, so far as we can see, mention the facts that potash saponifies oils more readily than does soda, and that potash soaps are found very much preferable to soda soaps wherever they have to come in contact with wool or woollen goods. He mentions the "Natrona refined saponifier," and also the preparation of soap by the consumer from the caustic soda (or potash) sent out by the Greenbank Alkali Company of St. Helens.

Bauxite is here said to be an aluminate of iron, and has assigned to it the formula $(AlFe)_2O_5H_4$. This scarcely agrees with analytical results. One of the finest qualities of bauxite now in the market contains 59·37 per cent of alumina and only 0·58 of ferric oxide. This is an Irish sample. French qualities generally contain more iron. We should be more apt to regard bauxite as a dihydrated alumina, containing iron, lime, titanic acid, and silica as impurities.

It is to be remarked that whilst some makers recommend alumina, aluminates, and aluminium silicates as useful additions to soap, others regard alumina as an injurious matter (Way's specification).

The methods given for bleaching oils and fats are the bichromate process, the use of nitric acid, chlorine, or bleaching-powder, the hot-air process, and the caustic soda and steam method. We believe that in bleaching these important articles there is still room for future improvement.

We fully admit that this book may prove widely useful, but we doubt whether, on comparing it with the treatises of Carpenter (1885) and of Watt (1884), it constitutes any distinct step in advance.

Introductory Inorganic Analysis. A First Course of Chemical Testing. By ERNEST H. COOK, D.Sc. (Lond.), F.C.S. London: J. and A. Churchill.

WE have been surprised, but by no means disagreeably, at the first few words of the author's Preface. He writes:—"This little book, strange though it may seem, has not been written to meet the requirements of any examination." There is no little dry sarcastic humour in the words "strange though it may seem." He proceeds:—"But in as far as examinations are tests of sound knowledge, it is hoped that it will be found useful for all." It would seem, therefore, that Dr. Cook is alive to the truth, which we trust is becoming more generally recognised, that examinations are not the sum and substance of education, and that their value as tests of sound knowledge is limited.

The introductory precepts to be remembered by the student are very good. We notice in particular that each operation should be written down in the note-book in three parallel columns:—Experiment; Observation; Inference.

As a first step—and that is all to which it lays claim—it may be safely recommended.

CORRESPONDENCE.

ALUMINIUM IN IRON.

To the Editor of the Chemical News.

SIR,—In reply to the above query in CHEMICAL NEWS, vol. lvii., p. 240, the following lines may perhaps afford some information. It is of course impossible to lay down any precise method of chemical analysis before having first examined the sample in particular, but the following method has been successfully worked in my laboratory on alloys containing iron, aluminium, manganese, silicon, and phosphorus.

The alloy is decomposed by HCl or aqua regia, evaporated to dryness by the aid of the water-bath, in order to

separate the silicon, re-dissolved by HCl, the solution rendered as neutral as possible, and an excess of ammonium succinate added. This precipitates the whole of the iron and aluminium, together with the phosphorus that exists as phosphates. The amount of phosphorus is then determined in a separate portion, afterwards calculated to P_2O_5, and subtracted from the iron and alumina precipitates; the difference gives the $Al_2O_3+Fe_2O_3$ obtained. The amount of iron present is next determined volumetrically by the aid of standard potassium bichromate, and the result obtained subtracted from the Al+Fe gives the percentage of Al.—I am, &c.,

H. N. Warren.

Liverpool Research Laboratory,
18, Albion Street, Liverpool.

FRENCH TECHNICAL TERMS.

To the Editor of the Chemical News.

Sir,—In answer to your correspondent, "Chemicus," an ordinary French and English Dictionary should be studiously avoided for the meaning of technical terms generally. The cause of this literary *hiatus* is not far to seek; lexicographers are not scientific men, and unfortunately translators will even give to an italicised word a meaning quite alien to the idea it is intended to express. In scientific or technical works, where special terms are met with, it is best to consult "Littre's Dictionnaire," which may be found in any good library.—I am, &c.,

Thomas T. P. Bruce Warren.

Tamworth Villa, Earlham Grove,
Forest Gate, E., June 24, 1888.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Note.—All degrees of emperature are Centigrade unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Vol. cvi., No. 24, June 11, 1888.

Refrigerating Mixtures obtained with Solid Carbonic Acid.—L. Cailletet and E. Colardeau.—The authors show that in a mixture of flocculent carbonic acid and ether the latter does not, as commonly supposed, act merely by establishing a more complete contact with the body to be refrigerated, but that cold is produced by the solution of the carbonic acid in the ether. Solid carbonic acid alone produced a temperature of −60° under the ordinary atmospheric pressure, and of −76° in a vacuum. A mixture of solid carbonic acid and ether gave, under ordinary atmospheric pressure, a temperature of −77°, and in a vacuum of −103°. The experiment was repeated with other solvents. Methyl chloride and liquefied sulphurous acid gave each −82°, acetamylic ether −78°, phosphorus trichloride −76°, and absolute alcohol −72°. In a mixture of methyl chloride and solidified carbonic acid in a vacuum a temperature of −106° was observed.

The Artificial Reproduction of Hydrocerussite, the Chemical Composition of this Mineral, and on the Constitution of White-Lead.—L. Bourgeois.—Hydrocerussite is a very rare basic lead carbonate found in small quantities at Langban, in Sweden, and at Wanlockhead. Its composition has been assumed to be PbO,CO_2+PbHO (Nordenskiöld). The author having prepared this product artificially gives its composition as $3PbO,2CO_2HO$. He considers that the white-lead of commerce is a mixture of cerussite and hydrocerussite.

Measurement of the Speed of Etherification by Means of Electric Conductivities.—M. Negreano.—To this mathematical paper we can merely draw attention.

On the Azo-derivatives of Benzene.—P. Petit.—The author determines the formation-heats of the azo-compounds derived from benzene: azo-oxybenzol, azobenzol, hydrazobenzol, and also of phenylhydrazine, bodies which may be considered as reduction-products intermediate between nitrobenzol and aniline.

Thermic Formation of the Salts of the Phenylene-diamines. Researches on Paraphenylene-diamine.—Leo Vignon.—The author measures the quantities of heat evolved by the union of acids with the three phenylene-diamines. He describes also three new compounds of paraphenylene-diamine, a hydrate, a sulphate, and an oxalate.

On the Formation of Amido-butyric Acid by the Direct Fixation of Ammonia upon Crotonic Acid.—M. Engel.—Crotonic acid fixes the elements of ammonia at 100°, and with the greatest ease. The yield is almost theoretical. No secondary product appears to be formed except a little oxybutyric acid. The amido-product is an amido-butyric acid, and is very probably β-amido-butyric acid.

Zeitschrift fur Analytische Chemie.
Vol. xxvi., Part 6.

Dehydromorphine (Oxydimorphine, Pseudomorphine).—As distinctions of this base from morphine, Hesse points out that morphine dissolves in pure strong sulphuric acid with a very faint reddish colour; pseudomorphine is at first colourless, but the solution soon becomes yellowish and reddish. If the acid contains a trace of ferric oxide it gives with morphine a reddish solution, but the pseudomorphine a blue solution, soon becoming deep violet and finally brownish green.

Colorimetric Determination of Salicylic Acid with Ferric Chloride.—Frehse finds that the following conditions are essential:—The comparative solution of a known strength must be frequently renewed, as it undergoes a gradual decomposition. The salicylic acid must be extracted with ether, not examining feebly-coloured liquids directly as acids; alkalies and neutral phosphates, oxalates, and tartrates interfere or even prevent the reaction. The solution of ferric chloride must be very dilute.

Determination of Small Quantities of Paratoluidine in Orthotoluidine.—C. Hæussermann.—The author pours a solution of 88 grms. crystallised oxalic acid in 750 c.c. water and 43 c.c. hydrochloric acid at 22° Beaumé, heated to 70° to 80°, into a porcelain capsule. He adds 100 grms. of the toluidine in question, and heats, whilst stirring, until the oxalate is completely dissolved. The liquid is then let cool slowly, still stirring occasionally, until a just visible separation of oxalate appears on the surface, which may take place between 30° and 35°, according to the proportion of the para-compound. As soon as a small quantity has crystallised out, and there ensues a pause in the crystallisation (*e.g.*, after separation of 0·5 grm.), it is quickly filtered through an open linen cloth, the residue is washed with a few drops of water, and slightly pressed. If this first crystallisation has a dead white appearance, without lustre, the filtrate after standing for a short time is filtered again, yielding a mass almost equal to the former. The collection of the several separations is continued until there are obtained not dull scales, but crystalline masses with bright surfaces, consisting of pure ortho-oxalate, and which after sufficient experience can be clearly distinguished from the earlier deposits containing para-oxalate. When this point is reached the liquid, which is now perfectly free from the para-compound, is set aside. The crystalline fractions are now distilled successively with a solution of sodium carbonate, and the base, which passes over with the watery vapour, is first submitted to a qualitative test, *i.e.*, it is cooled with ice and examined as to its congealing-point. If the sample becomes solid on mere stirring, the crystalline mass is collected on a tared filter,

pressed slightly, dried over caustic soda, and weighed as pure paratoluidine. If it congeals only on contact with a crystal of pure paratoluidine, only half its weight is calculated as paratoluidine.

Detection of Spermaceti in Oil of Roses.—G. Heppe.—The author shakes up the sample with 1½ to 2 vols. of melted glacial acetic acid. In a few minutes the mixture congeals to crystals. The mass is thrown upon a small filter, and washed with water until the smell of roses has almost disappeared. It is then washed with solution of soda, and again with water. The insoluble portion consists of spermaceti.

Ethereal Oils.—For these methods for distinguishing essential oils we must refer to the original.

Separation of Magenta from the Colouring-matter of Orchil. — C. Schweissinger. — If 0·25 grm. of pure orchil colour is extracted with alcohol, evaporated, the residue taken up in 50 c.c. water, mixed with 10 c.c. basic lead acetate, and filtered immediately, there is obtained a coloured filtrate which gives up the colouring-matter to amylic alcohol. If it is allowed to stand half an hour the colouring-matter is entirely deposited. If magenta is present the filtrate from the lead precipitate is coloured. The detection of acid magenta (magenta S) in orchil extract is effected as follows :—A small quantity is boiled up with excess of water and filtered. The clear filtrate is mixed with benzaldehyde, then tin crystals and hydrochloric acid are added, the whole well shaken up and let stand. If acid magenta is present the lower stratum is red; if not, it is colourless.

Detection of Arsenic by Marsh's Process. — G. Buchner.—The formation of the arsenical mirror depends on temperature, and is accelerated by a strong heat. According to N. P. Hamberg arsenic is eliminated from putrescent animal matter in the form of hydrogen arsenide.

Recognition of Chloroform after Death.—C. Luedeking.—Chloroform may be detected in the lungs of animals four weeks after death.

Bulletin de la Société Chimique de Paris.
Vol. xlix., No. 1.

On the Speed of the Reaction of Iceland Spar with Acids.—W. Spring.—All the surfaces of cleavage dissolve equally quickly, all other conditions remaining alike. The lines showing the variation of the speed of the reaction for the temperatures of 15° and 35° are almost right lines after a yield of 50 and 75 c.c. of carbon dioxide, and up to about 350 c.c. But at the temperature of 55° it is no longer the same, that is, the speed declines more rapidly than the concentration. Iceland spar is attacked only very slowly in hydrochloric acid of 2 per cent. This is a result very different from that observed in marble, where the reaction continues to the complete exhaustion of the acid. At each temperature tried the dissolving speed of spar is smaller than that of marble.

The Proportion of Carbon and Hydrogen contained in Coal-schists. A Contribution to the Study of the Formation of Coal.—W. Spring.—The formation and preservation of a coal rich in gas can only have occurred when it was sufficiently protected against atmospheric agencies. The many varieties of coal owe their origin probably rather to the unequal manner in which they have been protected against slow combustion than to a difference in the kinds of vegetation from which they are derived. Even in our epoch the fattest coals give the most abundant escapes of "fire-damp." The presence of this gas under a high pressure is a certain evidence of the impermeability of the rocks in which this coal has been shut up.

On Methyl-iodoform. — Pierre de Boissieu.— This compound melts with decomposition at 95°. It is very soluble in carbon disulphide, benzol, and ether, less so in petroleum ether, sparingly soluble in alcohol if cold, but more so if hot

Action of Crystalline Formic Acid upon Citrene.—J. Lafont.—The author obtains, among other products, a carbide, $C_{40}H_{32}$, probably analogous to that described by Deville and Reban, but which he names diterpilene.

The Sugars of Hesperidine and Isohesperidine.—C. Tanret.—The author has studied the saccharine matters produced when hesperidine and isohesperidine are split up under the action of dilute acids. The sugar derived from both these compounds is a mixture of glucose and of isodulcite.

Preparation of Isopropyl-acetylene with Methyl-isopropyl-carbonyl.—A. Béhal.—The removal of hydrogen from bi-halogenised carbides cannot be effected in the same manner as in the mono-substituted derivatives of the saturated carbons.

Application of Senarmont's Process to the Reproduction of Celestine and Anglesite in the Moist Way.—L. Bourgeois.—To obtain crystals of celestine the author dissolves strontium sulphate in an excess of hydrochloric acid in 2 vols. of water and heats the whole in a sealed tube to 150°. Anglesite in crystals may be produced in an analogous manner, using lead sulphate. The same method may be applied to the crystallition of lead chromate (crocoisite), using nitric instead of hydrochloric acid.

Influence of Certain so-called "Negative" Radicles upon the Functions of Certain Groupings.—Alb. Haller.—This memoir does not admit of useful abridgment.

NOTES AND QUERIES.

*** Our Notes and Queries column was opened for the purpose of giving and obtaining information likely to be of use to our readers generally. We cannot undertake to let this column be the means of transmitting merely private information, or such trade notices as should legitimately come in the advertising columns.

Preservation of Milk.—Can any reader inform me of a good preservative for milk? I know salicylic acid is sometimes used, but as this gives a slight flavour it will be useless for my purpose. I believe there must be something better. I should also like to know the length of time it would act.—H. E. S. H.

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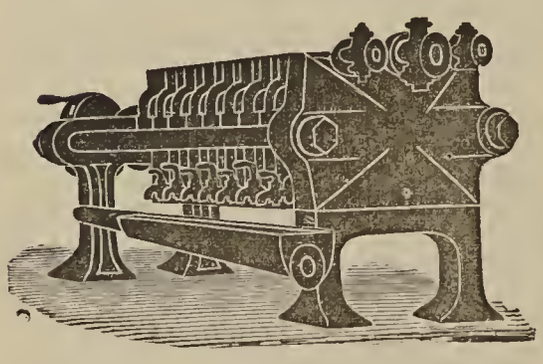

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